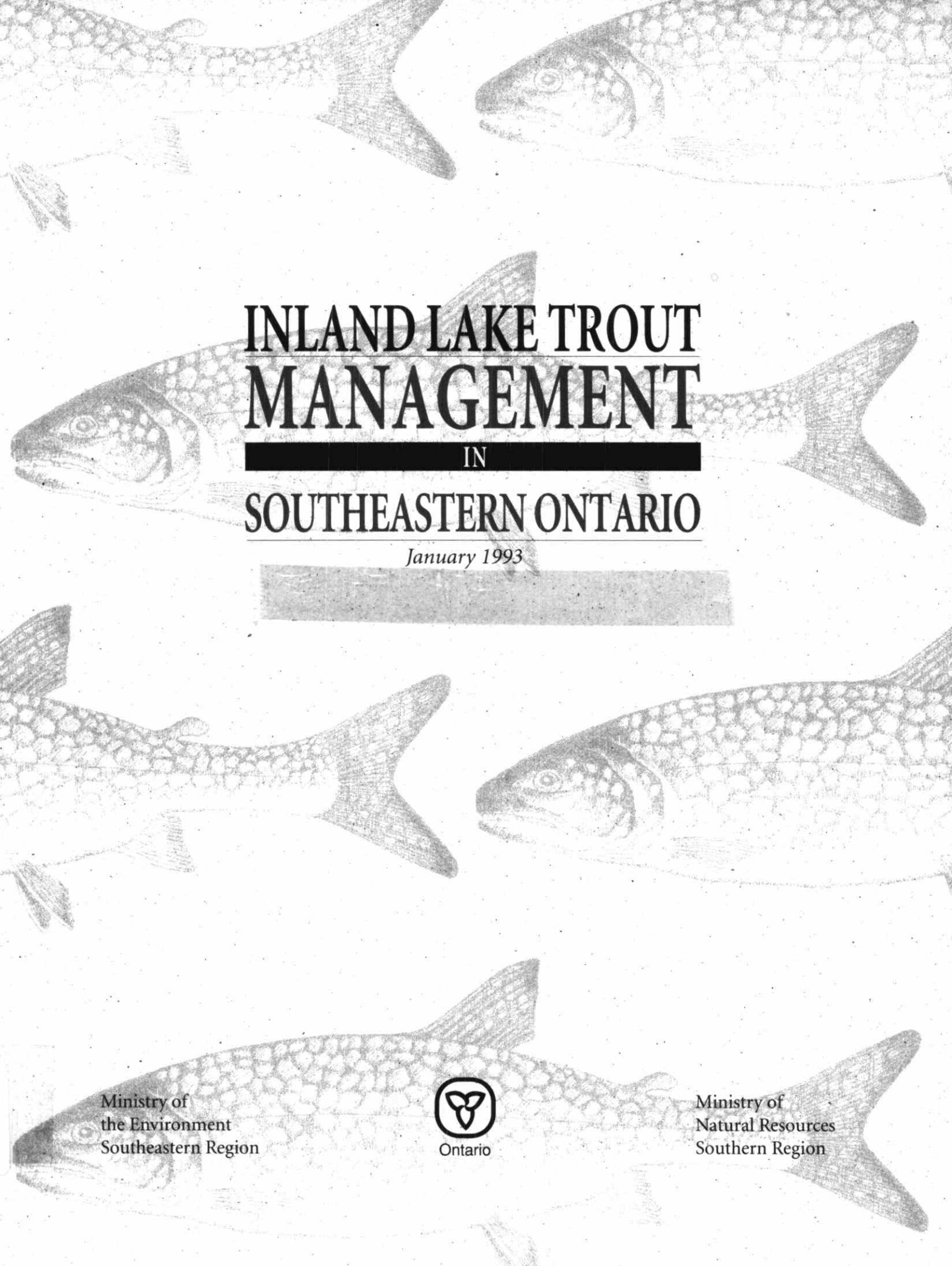

INLAND LAKE TROUT MANAGEMENT IN SOUTHEASTERN ONTARIO

January 1993

Ministry of
the Environment
Southeastern Region

Ontario

Ministry of
Natural Resources
Southern Region

THE CRITERIA TO DETERMINE THE SENSITIVITY OF LAKE TROUT LAKES TO FURTHER DEVELOPMENT ARE CURRENTLY BEING RE-EXAMINED. THE COMMENTS OF MNR AND MOE ON DEVELOPMENT PROPOSALS WILL REFLECT THE MOST UP-TO-DATE RESOURCE INFORMATION AVAILABLE.

January 31, 1993

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The Lake Trout, Salvelinus namaycush *Photo by K. Feigelman*

INLAND LAKE TROUT MANAGEMENT IN SOUTHEASTERN ONTARIO

January 1993

Ministry of
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Preface

DIMINISHING RESOURCE

Southeastern Ontario has the southernmost representation of inland lake trout lakes in Canada. Lake trout require cold, deep, well-oxygenated water for survival. Suitable lakes are finite and have been dwindling from the time of early settlement due to several major factors that have acted singly or in combination to eliminate lake trout habitat. The subsequent disappearance of native stocks began in the early 1900s and has continued at an accelerated rate until the present.

If steps are not taken to manage the remaining lake trout resources, the eventual extinction of lake trout as a self-sustaining species can be predicted in most lakes in eastern Ontario, perhaps before the end of the century.

IMPORTANCE

Today, lake trout represent one of the highest quality angling experiences in southeastern Ontario. The fish is esteemed for its sporting qualities and delicious flesh. The recreational experience associated with lake trout angling probably rivals the food value of the fish itself. Currently anglers spend in excess of 425,000 hours of effort each year seeking lake trout in southeastern Ontario waters. Estimated annual expenditures, made solely for lake trout fishing, are believed to exceed 1 million dollars.

A further value of lake trout is their use as a biological indicator of a healthy aquatic environment. For example, stresses on lake trout caused by deteriorating water quality are observable long before conditions such as the appearance of algae blooms and excessive aquatic plant growth become objectionable to humans.

RESPONSE

The Southeastern Region of the Ministry of the Environment and the former Eastern Region of the Ministry of Natural Resources have been co-operating on programs to protect the future of this valuable resource and to ensure lasting benefits.

In 1975, the two ministries initiated a lakes survey program intended to assist land use planners and resource managers in assessing the potential water quality and fisheries implications of shoreline development proposals. Of primary concern were the relatively few lakes in southeastern Ontario which had adequate water quality and habitat conditions to permit deep water fauna such as lake trout to survive.

The first phase of the program involved studies by the Ministry of the Environment designed to document existing water quality conditions for historical records as well as for assistance when commenting on shoreline development. The results were presented in the *Report on Water Quality Management of the Lake Trout Waters of Southeastern Ontario,* October 1977[1] and Volume II, February 1980[2]. These reports included interim recommendations to protect the water quality of the most sensitive waterbodies from the effects of shoreline development.

The second phase of the program involved studies by the Ministry of Natural Resources designed to assess factors other than water quality which have influenced or could influence the potential of lakes to be managed as lake trout fisheries.

1 Ontario Ministry of the Environment, 1977.

2 Ontario Ministry of the Environment, 1980.

Since the joint MOE-MNR program was initiated, the Ministry of Natural Resources has undertaken the development of a regional lake trout fisheries management strategy and the preparation of fisheries management plans for much of southeastern Ontario. These projects provided extensive opportunities for public discussion, refinement and review of fisheries management directions.

In addition, a Lake Trout Synthesis exercise was initiated to assemble the scientific information about lake trout and present it in a form that would facilitate new approaches to ensure the future management of the species. This project was completed in 1991 with the release of several working group reports. Also, the *Strategic Plan for Ontario Fisheries* (SPOF I)[3] was revised and updated. After extensive public review SPOF II[4] reaffirms the importance of healthy aquatic ecosystems and the need to protect habitat in order to maintain healthy fisheries.

The Ministry of the Environment is currently developing a strategy to standardize approaches to evaluate lake sensitivity and the setting of provincial water quality objectives [5]. Its purpose is to provide guidance in terms of water quality management and shoreline development decisions for lakes in the future.

This report summarizes the original findings and reflects the more recent work on water quality and fisheries management noted above. It recommends actions with respect to land use and development which will contribute to long-term water quality and fisheries management objectives for the lake trout waters of southeastern Ontario. It also will complement the implementation of approved district fisheries management plans. The recommendations in this report are subject to revision as new or refined resource information becomes available and as significant changes occur in policies or land use.

3 Ontario Ministry of Natural Resources and Environment Canada, 1976.

4 Ontario Ministry of Natural Resources, 1992.

5 Ontario Ministry of the Environment, 1992.

Acknowledgements

The work which has culminated in this report was initiated by D.F. Aitkins, Southeastern Region, MOE and W.G. Maslen, Eastern Region, MNR both of whom are now retired. Their dedication, enthusiasm and persistence are warmly recalled.

The Lake Trout Sub-committee of the Eastern Region Fish and Wildlife Technical Committee made significant contributions to the initial development of the management strategies. The original members were: Paul Bewick, Kerry Coleman, Gary Himburg, Neil MacLean, Alex Palilionis, Lindsay Penney, Gary Raine and Hans von Rosen. In addition, thanks is extended to those persons who attended public information forums on fisheries management and those who contributed written comments which assisted in the management decisions for this resource.

The helpful suggestions and assistance of David Root, Ministry of Municipal Affairs in devising practical approaches to land use development have been much appreciated.

Many permanent and casual employees of MOE and MNR have made valuable contributions to various components of the lakes survey program. These include the staff of the Westport Fish Culture Station; the Rideau Lakes Fisheries Assessment Unit; MNR offices at Brockville, Carleton Place, Napanee and Tweed; Fisheries Policy Branch, MNR; and Water Resources Branch, MOE.

The extensive lake sampling would not have been possible without the skilful piloting and technical assistance provided by contracted private air carriers. Special thanks is due to Madawaska Air Service, Parks Airnautical and Trent Air.

The co-operation of Ministry of Revenue staff in the property assessment offices at Brockville, Kingston and Trenton for assistance in determining the nature and extent of lakeshore development is gratefully acknowledged.

Particular thanks is extended to Margaret Carson who, with the assistance of Pat MacDonald, provided outstanding typing services through many revisions of the manuscript; to Laurie Dool for the cover artwork and her creative desktop publishing; and to Sue Martin for final production details.

Lastly, acknowledgement is given to the generous and sustained efforts of the joint MOE/MNR Recreational Lakes Committee whose members have been: D.F. Aitkins, P. Bewick, S.J. Kerr, L.W. Fitz, D. Galloway, R. Genge, M.J. German, R. Griffiths, M.M. Holy, R. Lingwood, W.G. Maslen, L.S. McCoy, J.D. Murray, G. Owen, D. Root, N. Ward and G.R. Whitney.

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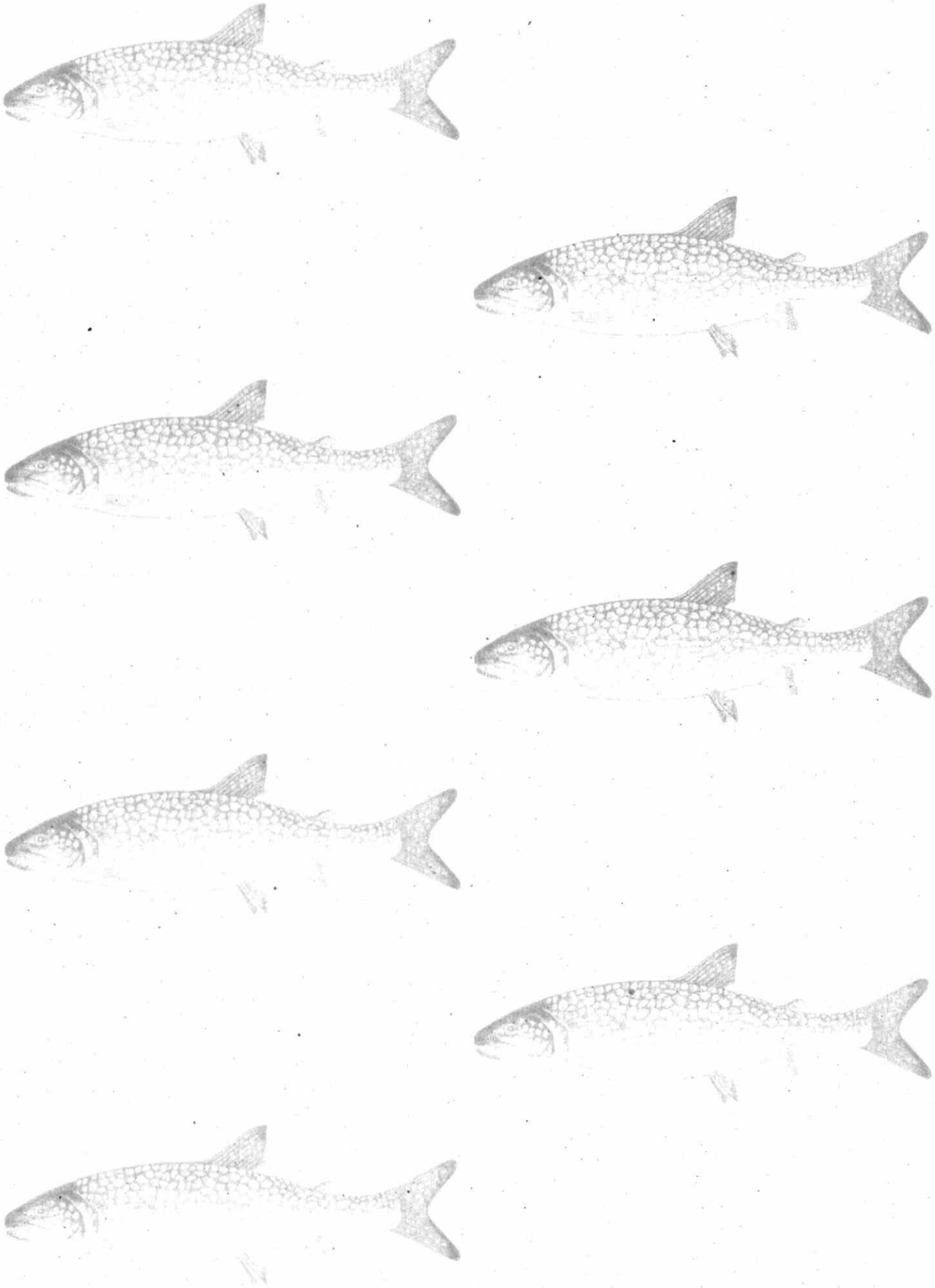


The Lake Trout Resource

GEOGRAPHIC DISTRIBUTION AND STATUS

The lake trout lakes in southeastern Ontario are scattered throughout a V-shaped portion of the Laurentian Shield which penetrates south to the St. Lawrence River between Brockville and Gananoque (Map). These waters represent the southernmost extension of inland lake trout habitat in Canada.

Lake trout lakes are limited in number, comprising only 6% of the total inland waters of southeastern Ontario. It should be noted that most of these lakes are readily accessible and near highly populated areas.

The current status of the inland lake trout resource base is summarized in Table 1. Southeastern Ontario once contained 70 lakes with native self-reproducing lake trout populations. Stocking of lake trout has been attempted to introduce and establish lake trout in a further 29 lakes. Native lake trout are now extinct in 16 lakes and hatchery introductions were unsuccessful in 8 lakes. There is little or no natural reproduction of lake trout in 35 lakes (16 native, 19 introduced). Twenty-two lakes (9 native, 13 introduced) contain remnant or marginal populations with a limited lake trout habitat that cannot be feasibly rehabilitated. Seven of the native lake trout lakes and 6 lakes with lake trout introductions have water quality conditions that can sustain a lake trout community through stocking and are considered holding basins. Only 38 native lake trout lakes and 2 lakes with introductions currently show evidence of significant lake trout reproduction.

In summary, the southeastern Ontario lake trout resource has dwindled from an original total of 99 native and stocked lakes to 53 lakes in 1992. Of these lakes, 13 serve as holding basins for stocked fish and 40 contain self-reproducing lake trout populations.

Southeastern Ontario lakes represent the southernmost inland lake distribution of lake trout in Canada

Ministry of Natural Resources Photo

LOCATION OF INLAND LAKE TROUT WATERS IN SOUTHEASTERN ONTARIO

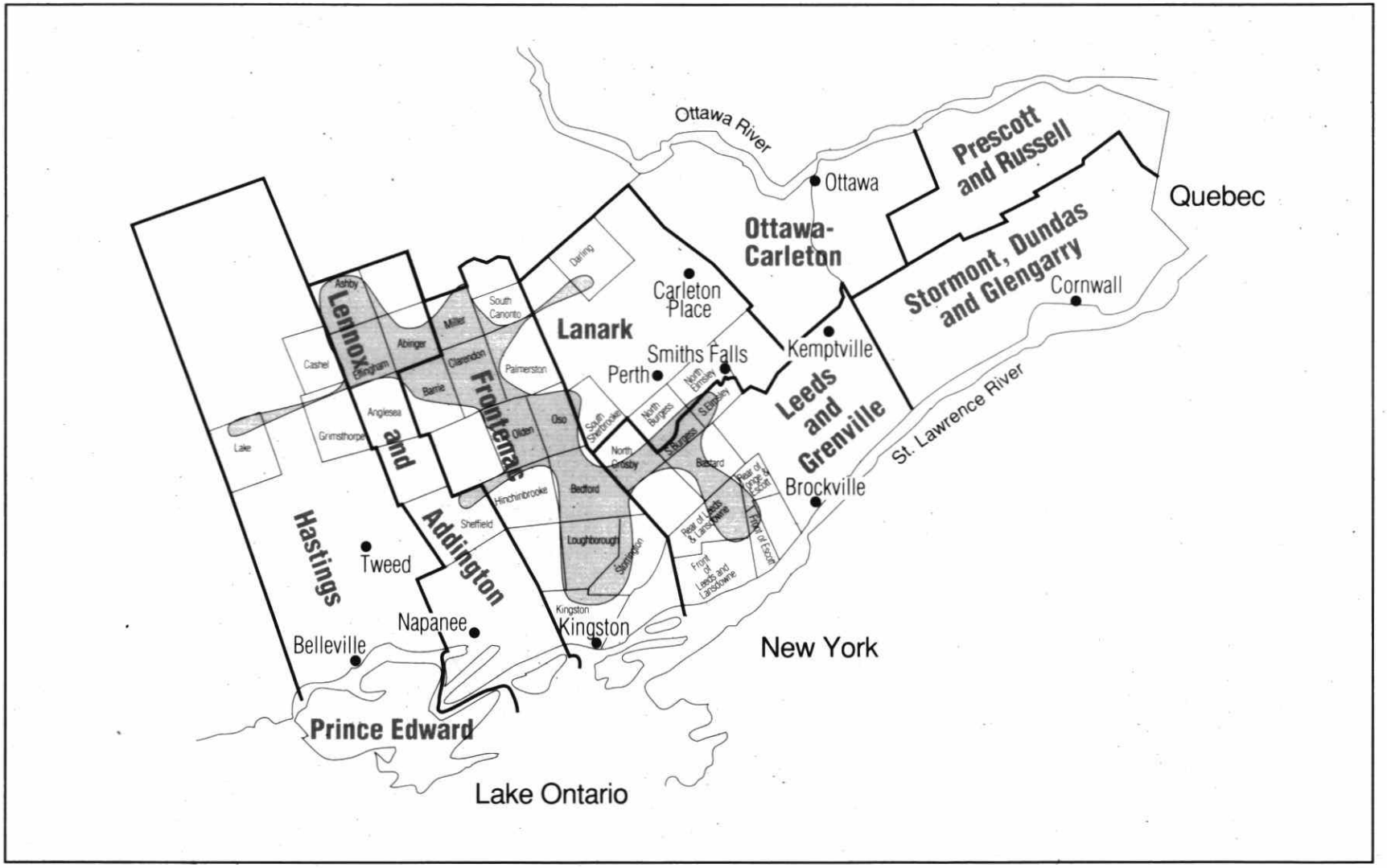


TABLE 1
CURRENT STATUS OF THE INLAND LAKE TROUT RESOURCE BASE SOUTHEASTERN ONTARIO

Status of Population	Lake Trout Origin				Remarks
	Native		Introduced		
	Number of Lakes	Surface Area (hectares)	Number of Lakes	Surface Area (hectares)	
Extinct	16	9762	8	1561	no longer support lake trout
Little or no reproduction					
• remnant or marginal populations with limited lake trout habitat	9	2437	13	619	not feasible to rehabilitate for lake trout
• adequate usable lake trout habitat with moderate populations	7	1919	6	714	feasible to stabilize and/or enhance as holding basins for lake trout
Significant reproduction	38	19750	2	77	many populations impaired but feasible to stabilize and/or enhance
Totals	70	33868	29	2971	99 lakes 36839 hectares

RATIONALE FOR INLAND LAKE TROUT MANAGEMENT

Lake trout fisheries offer a high quality angling and recreational experience.

The number of waterbodies supporting lake trout represents only a small percentage of Ontario lakes. Over the years, angler pursuit of this species has increased in popularity, resulting in an increased demand for this traditional sport fish. A significant number of natural lake trout populations are now extinct with many others impaired. Unless properly managed, these fisheries and the benefits they provide, will be lost. Loss of native reproducing stocks and the genetic resource base reduces lake trout management options.

In general, acid precipitation has a debilitating effect on provincial lake trout populations. Due to

the surficial geology of the area, most southeastern Ontario lake trout lakes are well protected against the effects of acid precipitation by natural buffering factors. Should remedial action to correct this international problem be only partially effective and/or require an excessive period of time to implement, the region's lake trout resource is in a favourable position to resist acid precipitation.

Southeastern Ontario's lake trout lakes are, in general, more productive than lake trout fisheries of central and northern Ontario. Therefore, the region's lake trout lakes have a potential for providing greater angling opportunities.

Lake trout is the primary sport fish species in many of the remaining coldwater lakes. The loss of lake trout lowers the ability of coldwater fisheries to satisfy angler demand for this type of angling opportunity.

Habitat requirements of lake trout are generally more demanding than those of other native sport fish species. Lake trout can act as an environmental barometer, serving as an early warning indicator of the general state of the environment. By protecting lake trout, most other cohabiting species also are automatically preserved.

Management of the inland lake trout resource of southeastern Ontario is shared by the Ministry of Natural Resources and the Ministry of the Environment through their respective legislative responsibilities and policy directions.

Ministry of Natural Resources Mandate

As the province's lead conservation agency, the Ministry of Natural Resources is the steward of public land and water resources. This mandate has been expressed in the following goal statement:

- to contribute to the environmental, social and economic well-being of Ontario through the sustainable development of natural resources[6].

Sustainability, for the Ministry of Natural Resources, means that decisions about development must be based on a consideration of both short and long term factors. It assumes a comprehensive assessment of environmental, social and economic effects, and their relevance from a local, regional, national and even international perspective.

In the Strategic Plan for Ontario Fisheries (SPOF II), the goal is to achieve healthy aquatic ecosystems that provide sustainable benefits contributing to present and future requirements for a high-quality environment, wholesome food, employment and income, recreational activity, and cultural heritage[7].

The Ministry of Natural Resources is responsible for determining a fisheries role for waterbodies to protect, enhance, maintain and rehabilitate fish communities and their environment. This report identifies those lakes in southeastern Ontario,

Lake trout management in Ontario depends upon a variety of federal and provincial legislation

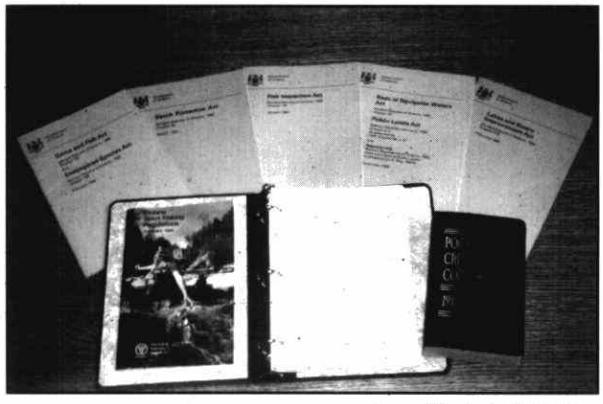


Photo by S. J. Kerr

6 Ontario Ministry of Natural Resources, 1991.

7 Ontario Ministry of Natural Resources, 1992.

currently and formerly supporting lake trout, which are manageable for lake trout or alternative species.

The following legislative authority provides purpose and direction for lake trout management in the province:

- the Ministry of Natural Resources, under the *Public Lands Act*, has charge of the management, sale, and disposition of public lands and forests[8].

- under the *Game and Fish Act*, the ministry provides for the management, perpetuation, and rehabilitation of the wildlife population, consistent with all other uses of lands and waters[9].

- the ministry administers the *Fisheries Act* of Canada and the regulations made under it pertaining to Ontario, to protect and manage the province's fisheries resources[10].

- the ministry administers the *Lakes and Rivers Improvement Act*, to provide for the use of waters of lakes and rivers of Ontario and to regulate improvements in them, and to provide for the use, management and perpetuation of the fish, wildlife, and other natural resources dependent on such waters[11].

Ministry of the Environment Mandate

The Ministry of the Environment mandate has been expressed in the following goal statement:

- to achieve and maintain a quality of the environment including air, water and land that will protect human health and the ecosystem and will contribute to the well-being of the people of Ontario[12].

In managing the water resources of the province, the ministry has closely inter-related programs to address both the quality and quantity aspects of surface and ground waters. Surface water quality management is the program most relevant to fisheries management in lakes.

The surface waters of Ontario are put to many uses, and each use has specific water quality requirements. Fishery water quality requirements are defined by the Provincial Water Quality Objectives, Table 1 in the publication *Water Management Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment*[13].

The goal for surface water quality management is to ensure that the surface waters of the province are of a quality which is satisfactory for aquatic life and recreation.

Two policies adopted to achieve this goal are important with respect to the protection of water quality for fisheries. They are:

Policy 1 In areas which have water quality better than the Provincial Water Quality Objectives, water quality shall be maintained at or above the Objectives.

Policy 2 Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives.

8 R.S.O. 1990, c.P.43, s.2.
9 R.S.O. 1990, c.G.1, s.3.
10 R.S.C. 1985, c.F-14.
11 R.S.O. 1990, c.L.3, s.2.
12 Ontario Ministry of the Environment, 1989.
13 Ontario Ministry of the Environment, 1984.

The lake trout lakes identified in this report include lakes of both Policy 1 and Policy 2 designation in terms of water quality conditions necessary for the management of lake trout. Therefore, for lakes having Policy 1 water quality conditions the ministry's actions will be directed towards maintaining existing water quality. For lakes having Policy 2 water quality conditions the ministry is obliged to prevent any further deterioration or improve water quality parameters essential for the management of lake trout.

The Ministry of the Environment's supporting role in lake trout management is to determine the existing level of water quality of designated lake trout lakes and to predict the effects of proposed development on this water quality.

The legislative authority for Ministry of the Environment actions in lake trout management include:

- the ministry under the *Ontario Water Resources Act* and its implementing policy, and the *Fisheries Act* has the authority to control the discharge of contaminants to surface waters which have the potential to harm ***fish habitat***[14].

- the *Environmental Protection Act* provides the ministry or its designees the authority to protect the aquatic environment against impairment which might result from private waste disposal systems[15].

- under the *Pesticides Act* the ministry has the authority to regulate the marketing of pesticides and their commercial use which may unduly affect the environment or aquatic life and/or impair the use of aquatic life[16].

14 R.S.O. 1990, c.O.40, s.28; R.S.C. 1985, c.F-14.

15 R.S.O. 1990, c.E.19, s.74; s.77(2) (d) (iv).

16 R.S.O. 1990, c.P.11, s.11(1).

FISHERIES POTENTIAL

Assessment Methodology

To help determine the most appropriate fisheries role for an individual lake, the lakes were assessed for their ability to support lake trout and to generate angling opportunities. To assist in this determination, a dual method of grouping lakes into classes and categories was developed.

Classification was based on the lake's ability to support natural recruitment. The criteria for the three classes are:

Class 1 — supports natural reproduction
Class 2 — does not support reproduction; holding basin
Class 3 — lakes in which lake trout are no longer present; extinct.

Categorization was based on a blend of biological, physical, social, and economic considerations. Four categories were developed, distinguishable by an assessment of angling quality, water quality conditions and rehabilitation potential.

The criteria for the four categories developed are as follows:

Category 1

- Lakes which currently provide a lake trout fishery offering a social and economic benefit and/or provide a unique recreational experience. In other words, good lake trout populations which sustain moderate to high harvests.

- Lakes which provide optimum lake trout water quality conditions defined as oxygen of 6 µg/L or more and temperature of 10°C or less. In other words, good water quality conditions for lake trout.

- Lakes where stabilization or enhancement of the environment and/or the lake trout community is deemed to be feasible.

Category 2

- Lakes which currently provide a lake trout fishery usually on a magnitude less than those identified in Category 1. In other words, adequate lake trout populations which sustain moderate harvests.

- Lakes which are considered to offer usable lake trout water quality conditions defined as oxygen of at least 4 µg/L and temperature of 15.5°C or less. In other words, adequate water quality conditions for lake trout.

- Lakes where stabilization or enhancement of the environment and/or the lake trout community may be feasible.

Category 3

- Lakes which contain remnant or marginal lake trout populations. In other words, poor lake trout populations and a low level of harvest.

- Lakes which contain limited lake trout habitat that cannot feasibly be rehabilitated.

- Lakes which are incapable of supporting any significant amount of natural lake trout reproduction but which could now provide alternative coldwater fisheries management opportunities.

Category 4

- Lakes in which lake trout are no longer present.

- Lakes where water quality conditions cannot feasibly be rehabilitated for lake trout.

- Lakes which could now provide alternative coolwater and/or warmwater fisheries management opportunities.

Fisheries Role Designation

By using the established criteria for each class and category, the 99 former and current lake trout lakes within southeastern Ontario were placed within a matrix (Table 2).

The results of this assessment are as follows:

- 53 lakes were identified to have water quality, general habitat conditions and lake trout population characteristics conducive to the maintenance of manageable lake trout populations. This includes lakes which have self-sustaining lake trout populations as well as those where lake trout must be stocked in order to retain lake trout fisheries (Categories 1 and 2).

- 22 other lakes which currently have lake trout populations, were deemed not manageable for lake trout (Category 3).

- An additional 24 lakes were identified as once having lake trout populations in which lake trout are now extinct. These lakes also were deemed not manageable for lake trout (Category 4).

Lakes placed in Categories 1 and 2 have lake trout assigned as their primary fisheries role. These 53 lakes are the subject of the water quality modeling and the management actions identified in this report.

Lakes placed in Categories 3 and 4 have an assigned primary fisheries role for species other than lake trout. An alternative coldwater fisheries management program has been recommended for the majority of Category 3 lakes, while a coolwater and/or warmwater fisheries management program is suggested for most Category 4 lakes.

TABLE 2
CLASS AND CATEGORY OF FORMER AND CURRENT INLAND LAKE TROUT LAKES SOUTHEASTERN ONTARIO

CATEGORY	CLASS 1 SUPPORTS REPRODUCTION			CLASS 2 HOLDING BASIN		CLASS 3 EXTINCT	TOTAL
1	Ashby	Buck (S. Basin)	Knowlton	Loughborough (W.Basin)			31
	Ashden (Ashby White)	Canoe	Lucky	Red Horse			
	Barker	Charleston	Mackie				
	Barnard	Crow[17]	Otter (Cotter)[18]				
	Big Clear	Crystal	Palmerston				
	Big Ohlmann	Desert	Round Schooner				
	Big Rideau	Devil	Shabomeka				
	Big Salmon	Dickey	Trout (Len)				
	Birch	Eagle	Wensley (Brule)				
		Kishkebus	Weslemkoon				
2	Buck (N. Basin)	Joeperry	Rainy	Bobs (Green Bay)	Loyst		22
	Effingham	Little Green	Sharbot (W. Basin)	Gould	Murray		
	Fox	Mazinaw	Thanet	Hungry	Potspoon		
	Grimsthorpe	Mosque		Little Mackie (Camp)	Reid		
				Long Mallory	Silver		
					Simpson		

3	Bailey	Leo	22
	Big Mair	Little Clear	
	Dog (NE Basin)	Little Merrill	
	Draper	Little Salmon	
	Elzevir	Lower Beverley	
	Granite	Mair (Green)	
	Grindstone	McCausland	
	Garter	Napier	
	Indian	Otter [19]	
	Kilbourne	Spring	
	King	White [20]	
4	Big Burnt	Labelle	Tangamong
	Buckshot	Long Schooner	Troutling Bay
	Canonto	Marble	Thirty Island
	Clarendon (Big Gull)	Merrill	Upper Rideau
	Crotch (Cross)	Mississagagon	Whetstone
	Crow [21]	Puzzle	White [22]
	Fortune	Robertson	Whitefish
	Kashwakamak	Skootamatta	Wolfe

24

17 Bedford and Oso Townships
18 Ashby Townships
19 South Elmsley and Bastard Townships
20 Bedford Township
21 Storrington and South Crosby Townships
22 Olden Township

WATER QUALITY

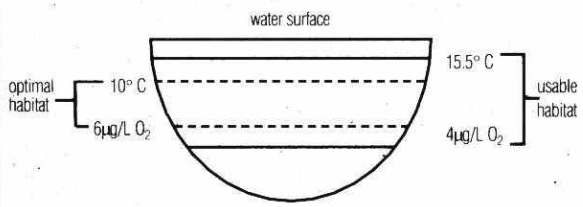
As described in the preceding section of this report, the Ministry of Natural Resources has identified 53 lakes in southeastern Ontario for which long term management of lake trout is proposed. In order to ensure that the resource remains viable, protection of the water quality suitable for lake trout management is essential.

This section of the report describes specific water quality requirements of lake trout, the existing water quality of the 53 lakes and the susceptibility of these lakes to changes in water quality as a result of increased nutrient loadings.

Water Quality Requirements for Lake Trout

The most critical water quality conditions for lake trout develop during late summer. At this time of year, water temperature and dissolved oxygen conditions combine to restrict the portion of the lake containing suitable water quality for lake trout.

Figure 1 — Suitable Water Quality Conditions for Lake Trout



Lake trout require water temperatures of 15.5°C or cooler and dissolved oxygen concentrations of 4 µg/L or greater for survival[23]. Lakes warm from the surface downward and lose oxygen from the bottom upward. The usable portion of the lakes meeting these limits becomes restricted to a mid-depth zone above which water temperatures are 15.5°C or warmer and below which dissolved oxygen concentrations are 4 µg/L or less.

While lake trout can survive under the temperature and oxygen conditions described above, optimal conditions for the species are confined to temperatures of 10°C or cooler[24] and dissolved oxygen concentrations of 6 µg/L or greater[25].

Therefore, within the zone containing usable lake trout habitat, there exists a stress-free zone. This zone is referred to as the optimal habitat for lake trout.

Throughout the remainder of this report, the terms ***usable*** and ***optimal lake trout habitat*** will be used to refer to water quality meeting the oxygen and temperature conditions described above.

Lake Processes

In order to understand factors influencing the water quality of a lake, it is necessary to consider several natural lake processes. Lakes in southeastern Ontario, typical of other north temperate lakes, undergo an annual cycle that involves physical, chemical and biological changes affecting temperature and oxygen concentrations and which have a significant influence on the amount of lake trout habitat available. These natural processes are predictable and are guided by the seasons.

23 Martin and Olver, 1976.

24 Scott and Crossman, 1973; MacLean et al., 1990.

25 Ontario Ministry of the Environment, 1984; MacLean et al., 1990.

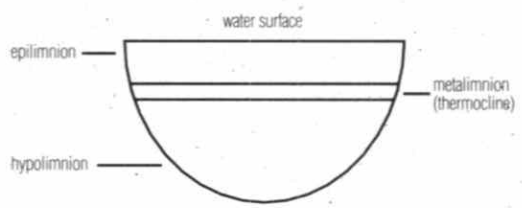
Physical Changes

During the winter when lakes are ice-covered, water temperatures range from 0°C at the surface to 4°C at the bottom. In the spring, after ice-out, the entire lake volume is at or slightly warmer than 4°C, the temperature of maximum water density. At this time, the physical force of wind action is capable of mixing the entire lake volume. The net result is relatively uniform water quality from surface to bottom.

Following this brief period of spring mixing, warmer weather brings about a gradual heating of the surface waters. The warmer surface water is less dense than the colder bottom water and therefore floats over the bottom water. This temperature dependent density gradient divides the lake into the ***epilimnion,*** the zone of warm surface water which is continually mixing and in contact with the atmosphere, and the ***hypolimnion,*** the zone of deep, cold and relatively undisturbed bottom water. Once this separation of surface and bottom water strata is set up, the lake is said to be stratified.

Between the epilimnion and the hypolimnion, there is a zone of maximum rate of decrease in temperature termed the ***metalimnion (thermocline)*** and this zone serves to maintain ***stratification.*** (Figure 2).

Figure 2 — Zones of Summer Lake Stratification



During summer stratification, wind-induced physical mixing will mix warm water in the lakes to different depths. The depth of mixing is determined to some extent by lake area, fetch and local topography, as well as other features. In general, lakes with a long fetch, flat local topography and large surface area mix deeper than lakes exhibiting contrasting characteristics. The effect of greater exposure acts to deepen the epilimnion, but does not play a role in the temperature regime below the thermocline. In general, warming of the surface water confines lake trout to a depth deeper than seven to eight metres from the surface at the end of summer.

During late August or early September, a brief period exists when there is little net gain or loss of heat, after which the surface of the lakes begins to cool. The cooling process results in a gradual lowering of temperatures in the epilimnion and the eventual breakdown of the thermocline as the temperature of the surface layer more closely matches that of the hypolimnion.

Stratification breakdown is complete when epilimnion temperatures equal hypolimnion temperatures and wind-induced mixing results in fall overturn. A relatively long period of autumnal circulation is normal until the lake surface temperatures drop below 4°C and ice cover is established.

Chemical Changes

From the standpoint of lake trout the most important chemical changes are those which affect the amount of oxygen present in the water. During the spring mixing period previously described, lakes gain oxygen at the surface by exposure to the atmosphere. In addition, where light penetration is sufficient, oxygen is supplied through photosynthesis by algae.

Theoretically, at the time of spring overturn, the entire lake gains oxygen and if mixing is complete and of sufficient duration, the oxygen concentration will approach saturation throughout

the lake. Although most lakes undergo complete mixing, some do not achieve 100% oxygen saturation in deep zones before the onset of summer stratification. Lakes with a great depth, small surface area or sheltered from the wind may undergo only partial mixing. These lakes could enter the summer stratification period with less than saturated oxygen conditions in the hypolimnion.

Once stratification is established, the surface water continues to be supplied with oxygen through exchange with the atmosphere and by photosynthesis. Both algae and rooted plants produce oxygen in the presence of inorganic nutrients and light. Although there is a demand for oxygen in the epilimnion through plant respiration and the decomposition process, the supply of oxygen greatly exceeds the demand. Wind-induced mixing ensures the distribution of oxygen in the epilimnion.

The hypolimnion has to acquire enough oxygen in the spring to support aquatic life throughout the stratified season. Since photosynthetic oxygen production is light-dependent and adequate light penetration seldom reaches the hypolimnion, only the surface water is available for photosynthetic oxygen production. In the hypolimnion, oxygen is gradually consumed during the stratified season by biochemical processes which include respiration by living organisms, reduction by oxygen-consuming chemical reactions, and most importantly by bacterial decomposition of organic matter supplied to the hypolimnion.

Fall overturn results in replenishment of oxygen to the hypolimnion. Wintertime conditions beneath the ice generally do not result in limiting conditions for lake trout since production and decomposition of organic matter proceeds more slowly and temperature is not restrictive.

Biological Changes

Organic matter responsible for oxygen depletion in the hypolimnion of a lake is produced in the epilimnion primarily in the form of algae. The algae are continuously being produced; however, algae only live for a short period of time. In general, dead algal cells sink into the hypolimnion and form a continuous supply of organic matter during the stratified season.

The amount of plant ***biomass*** or organic matter produced is dependent upon the availability of the most limiting nutrient. In lakes, phosphorus is the nutrient which is normally least available relative to plant requirements and therefore the nutrient which determines the amount of organic matter produced. Since the concentration of phosphorus influences the quantity of algae or organic matter being produced, which in turn influences the oxygen condition of the hypolimnion, it follows that an increase in phosphorus supply to a lake can adversely affect lake trout habitat through oxygen depletion.

Phosphorus is supplied to a lake naturally from surface runoff, inflowing streams, and directly onto the lake surface in the form of rainfall and dust. Human sources of phosphorus supplied to lakes include leachate from private waste disposal systems, erosion associated with disturbance of shoreline vegetation and clearing of cottage lots, addition of artificial phosphorus to shoreline lawns or through agriculture, forestry, and other land use activities in the watershed.

The amount of algae in the water is commonly determined by a measurement of the concentration of green pigment or chlorophyll in the water. All reference to the term chlorophyll in this report refers to the ***chlorophyll a*** pigment.

The combined impact of all of the above lake processes determines the amount of lake trout habitat available at the end of the stratified

season. Even small increases in phosphorus supply may have large impacts on lake trout habitat in sensitive lakes. Specific lake by lake morphometric and water quality parameters are described in the sections that follow.

Description of Study Lakes

Morphometry

Lake ***morphometry*** refers to the physical features, such as shape and size, of a lake. The morphometric features described for the purposes of this assessment are the lake surface area, the total lake volume, the lake mean depth, and the maximum depth. The mean depth is determined as the total volume divided by the area.

The morphometry of the 53 lakes considered in this report varies substantially (Table 3). In terms of size, lake areas range from 16 hectares to 4 648 hectares for Loyst Lake and Big Rideau Lake respectively. The lake volumes range from a low value of 2.274 x $10^6 m^3$ for Loyst Lake to a high of 713.449 x $10^6 m^3$ for Big Rideau Lake.

Mean depths range from 43.1 metres for Mazinaw Lake to 7.3 metres for Hungry Lake and Joeperry Lake. The deepest lake is Mazinaw at 144.8 metres, while the shallowest, Grimsthorpe Lake, has a maximum depth of only 15.2 metres.

The morphometric features act together with water quality to determine the amount of lake trout habitat available.

TABLE 3
LAKE MORPHOMETRY

LAKE	SURFACE AREA x $10^6 m^2$	TOTAL LAKE VOLUME x $10^6 m^3$	MEAN DEPTH m	MAX DEPTH m
Ashby	2.66	30.840	11.6	36.6
Ashden (Ashby White)	1.38	13.690	9.9	25.0
Barker	1.73	22.110	12.8	38.1
Barnard	0.39	7.350	18.8	48.2
Big Clear	1.69	34.270	20.3	61.0
Big Ohlmann	0.32	6.570	20.5	42.1
Big Rideau	46.48	713.449	15.3	100.3
Big Salmon	1.71	22.900	13.3	42.0
Birch	1.95	34.000	17.4	40.0
Bobs (Green Bay)	5.34	61.508	11.5	25.6
Buck (North Basin)	2.64	28.299	10.5	32.0
Buck (South Basin)	4.91	60.990	12.4	41.0
Canoe	2.91	66.690	22.9	47.0
Charleston	25.17	433.500	17.2	91.2
Crow	4.42	59.750	13.5	38.0
Crystal	0.50	4.690	9.4	32.0
Desert	4.02	81.100	20.2	68.0
Devil	10.62	152.200	14.3	45.0
Dickey	2.08	37.930	18.2	51.0
Eagle	6.46	83.880	13.0	31.1

LAKE	SURFACE AREA $x\ 10^6 m^2$	TOTAL LAKE VOLUME $x\ 10^6 m^3$	MEAN DEPTH m	MAX DEPTH m
Effingham	1.97	18.477	9.4	23.0
Fox	0.27	3.446	13.0	31.0
Gould	1.99	39.939	20.1	61.0
Grimsthorpe	0.94	7.342	7.7	15.2
Hungry	2.55	18.540	7.3	32.0
Joeperry	1.69	12.350	7.3	23.0
Kishkebus	0.85	11.430	13.4	32.9
Knowlton	1.82	27.830	15.3	34.0
Little Green	0.29	3.495	12.0	21.0
Little Mackie (Camp)	0.53	6.342	11.9	36.4
Long Mallory	0.63	4.970	7.9	17.4
Loughborough (West Basin)	7.38	109.045	14.6	38.4
Loyst	0.16	2.274	14.0	31.0
Lucky	1.00	11.820	11.8	27.7
Mackie	1.58	13.740	8.7	23.0
Mazinaw	15.90	684.900	43.1	144.8
Mosque	1.38	10.204	7.4	34.0
Murray	0.18	2.286	12.7	27.5
Otter (Cotter)	3.06	26.310	8.6	29.3
Palmerston	5.63	115.900	20.6	56.0
Potspoon	0.79	7.297	9.3	27.0
Rainy	0.45	4.278	9.5	17.0
Red Horse	3.02	30.620	10.1	36.9
Reid	1.05	8.090	7.7	19.8
Round Schooner	1.92	28.860	15.0	32.0
Shabomeka	2.68	33.990	12.7	32.0
Sharbot (West Basin)	6.84	63.829	9.3	31.1
Silver	2.46	25.342	10.2	24.4
Simpson	0.25	2.652	10.6	18.6
Thanet	1.12	8.760	7.8	24.4
Trout (Len)	1.58	22.910	14.5	33.5
Wensley (Brule)	5.71	126.300	22.1	56.4
Weslemkoon	19.55	168.700	8.6	54.9

Measured Water Quality

Water quality data for the lakes described in this report were gathered over a period of several years beginning in 1971. Each lake was sampled on a number of occasions from spring until fall. The water quality parameters pertinent to this report are phosphorus, chlorophyll, dissolved oxygen and temperature. The data are presented in a summarized form by lake in Appendix B.

In addition, samples were analyzed for other parameters to provide supporting data.

The temperature and oxygen values meeting usable and optimal criteria were selected from measured oxygen and temperature recordings taken from the lake surface to the lake bottom for each sampling date. The volume of water meeting the usable and optimal criteria was then calculated and expressed as a percentage of the total lake volume.

Water quality data has been collected on an ongoing basis for most inland lake trout lakes in southeastern Ontario

Ministry of the Environment Photo

From these data, lake to lake comparisons can be made of existing optimal and usable volumes of water for lake trout management purposes. A preliminary examination of the oxygen-temperature data for the 53 lakes manageable for lake trout revealed that the volume of water meeting these criteria is most restrictive on or about August 31 for any year.

After August 31, the surface waters begin to cool. In general, as the surface water cooling occurs, lake trout are able to move up in the water column and avoid the poor oxygen conditions which continue to develop below. Oxygen depletion continues to occur in the hypolimnion through to fall overturn; however, the habitat gained in the surface layer due to cooling exceeds that lost in the hypolimnion due to oxygen depletion.

Considering these general observations, the ideal data set for making lake to lake comparisons of existing lake trout habitat at the most critical time of year would be a dissolved oxygen and temperature profile for each lake taken on or about August 31.

In dealing with such a large group of lakes it is not logistically possible to sample each lake on the same date. However, one can readily measure the rate of dissolved oxygen depletion occurring in a lake from this information and, by extrapolation, predict the oxygen concentration which would exist on August 31.

The method used in this assessment involved calculating the rate of loss of oxygen from each one metre layer of the hypolimnion based on the difference in oxygen concentrations between sample dates before and after August 31. This depletion rate value was used to extrapolate forward or backward from the closest sampling date to August 31 to construct the dissolved oxygen concentration in each layer that would have been measured on August 31.

From the calculations described above, the water volumes of optimal and usable lake trout habitat were determined for each lake for a common date. In this report optimal and usable lake trout water volumes for the common date of August 31 will be referred to as the ***standardized habitat.***

The standardized habitat was calculated for all of the lakes except Barnard, Crystal, Mazinaw and Trout (Len). Insufficient data exist at present to calculate oxygen depletion rates for these lakes. The reported optimal and usable lake trout habitat values for these three lakes are those actually measured on the sampling date closest to August 31.

The standardized optimal and usable habitats (water volumes) for each lake are presented in Tables 4 and 5, respectively. In addition, the proportion of the total lake volume exceeding criteria for optimal and usable habitats is presented.

TABLE 4
OPTIMAL HABITAT STANDARDIZED TO AUGUST 31 AND PROPORTION OF LAKE VOLUME EXCEEDING CRITERIA FOR OPTIMAL VOLUME

LAKE	SAMPLING YEAR	OPTIMAL VOLUME 10^6m^3	OPTIMAL VOLUME AS A % OF TOTAL VOLUME	VOL.>10.0°C AS A % OF TOTAL VOLUME	VOL.<6 ppm O_2 AS A % OF TOTAL VOLUME
Ashby	1976	5.720	19	75	6
Ashden (Ashby White)	1976	2.240	16	55	29
Barker	1976	9.870	45	52	3
Barnard *	1982	1.610	22	44	36
Big Clear	1981	15.240	44	47	9
Big Ohlmann	1980	0.510	8	31	61
Big Rideau	1990	275.190	39	61	0
Big Salmon	1981	7.790	34	55	11
Birch	1975	7.940	23	43	34
Bobs (Green Bay)	1990	5.339	9	67	24
Buck (N. Basin)	1987	0	0	66	44
Buck (S. Basin)	1979	7.180	12	51	37
Canoe	1975	29.740	45	34	21
Charleston	1981	207.410	48	52	0
Crow	1981	12.680	21	60	19
Crystal *	1982	1.790	38	56	6
Desert	1975	25.950	32	37	31
Devil	1975	44.900	29	50	19
Dickey	1976	22.120	58	42	0
Eagle	1975	16.140	19	56	25
Effingham	1976	2.720	15	70	15
Fox	1981	0.740	21	50	29
Gould	1987	23.043	58	41	2
Grimsthorpe	1985	0	0	63	50
Hungry	1976	0	0	65	35
Joeperry	1976	0	0	74	26
Kishkebus	1976	1.800	16	45	39
Knowlton	1975	6.400	23	51	26
Little Green	1980	0.668	19	59	22
Little Mackie (Camp)	1981	1.945	31	56	13
Long Mallory	1976	0.530	11	71	17
Loughborough (W. Basin)	1989	0	0	65	49
Loyst	†	†	†	†	†
Lucky	1976	1.660	14	58	28
Mackie	1976	0.650	5	71	24
Mazinaw *	1971	540.520	79	19	2
Mosque	1976	0	0	75	29
Murray	†	†	†	†	†
Otter (Cotter)	1976	8.220	31	64	5
Palmerston	1980	61.500	53	42	5
Potspoon	1979	0	0	60	41
Rainy	1985	0	0	60	55
Red Horse	1981	0	0	58	42
Reid	1976	0	0	77	23
Round Schooner	1976	9.240	32	51	17
Shabomeka	1976	9.310	27	62	11
Sharbot (W. Basin)	1979	2.550	8	70	26
Silver	1979	0	0	61	39
Simpson	1982	0.315	12	54	34
Thanet	1976	0.350	4	68	28
Trout (Len) *	1978	4.580	20	42	38
Wensley (Brule)	1976	70.750	56	41	3
Weslemkoon	1976	45.670	27	69	4

† no water quality data available ** not standardized data (based on best estimate)*

TABLE 5
USABLE HABITAT STANDARDIZED TO AUGUST 31 AND PROPORTION OF LAKE VOLUME EXCEEDING CRITERIA FOR USABLE VOLUME

LAKE	SAMPLING YEAR	USABLE VOLUME $10^6 m^3$	USABLE VOLUME AS A % OF TOTAL VOLUME	VOL.>15.5°C AS A % OF TOTAL VOLUME	VOL.<4 ppm O_2 AS A % OF TOTAL VOLUME
Ashby	1976	13.570	44	55	1
Ashden (Ashby White)	1976	4.740	35	49	16
Barker	1976	12.680	57	43	0
Barnard *	1982	4.150	56	37	7
Big Clear	1981	19.830	58	41	1
Big Ohlmann	1980	1.010	15	27	58
Big Rideau	1990	373.890	52	48	0
Big Salmon	1981	11.460	50	47	3
Birch	1975	21.240	64	31	5
Bobs (Green Bay)	1990	19.291	31	58	11
Buck (N. Basin)	1987	0	0	58	42
Buck (S. Basin)	1979	31.070	51	46	3
Canoe	1975	45.830	69	31	0
Charleston	1981	286.240	66	34	0
Crow	1981	29.050	49	51	0
Crystal *	1982	2.590	55	44	1
Desert	1975	49.300	61	33	6
Devil	1975	87.690	58	38	4
Dickey	1976	26.770	71	29	0
Eagle	1975	38.940	47	51	2
Effingham	1976	8.480	46	52	2
Fox	1981	1.640	48	34	18
Gould	1987	24.825	62	37	1
Grimsthorpe	1985	3.566	42	50	1
Hungry	1976	4.720	26	58	16
Joeperry	1976	4.140	34	59	7
Kishkebus	1976	6.550	57	34	9
Knowlton	1975	12.970	47	44	9
Little Green	1980	1.199	34	48	18
Little Mackie (Camp)	1981	2.678	42	47	11
Long Mallory	1976	1.560	31	59	10
Loughborough (W. Basin)	1989	43.808	40	55	5
Loyst	†	†	†	†	†
Lucky	1976	3.440	29	48	23
Mackie	1976	4.660	34	53	17
Mazinaw *	1971	588.430	86	13	1
Mosque	1976	1.240	12	63	25
Murray	†	†	†	†	†
Otter (Cotter)	1976	15.380	58	42	0
Palmerston	1980	72.140	62	36	2
Potspoon	1979	2.710	37	54	9
Rainy	1985	1.206	28	45	27
Red Horse	1981	14.600	48	46	6
Reid	1976	1.440	18	59	23
Round Schooner	1976	12.900	45	46	9
Shabomeka	1976	17.770	52	46	2
Sharbot (W. Basin)	1979	16.500	26	59	14
Silver	1979	2.660	11	55	34
Simpson	1982	0.666	25	41	34
Thanet	1976	1.580	18	65	17
Trout (Len) *	1978	12.960	57	33	10
Wensley (Brule)	1976	82.120	65	35	0
Weslemkoon	1976	52.300	35	62	3

† no water quality data available ** not standardized data (based on best estimate)*

Optimal Habitat Model for Lake Trout

Lake processes produce the physical, chemical, and biological changes previously discussed. These changes act together to produce the optimal and usable lake trout habitat remaining at the end of the stratified season.

Lake surveys document water quality and existing volume suitable for lake trout as baseline data for comparison with future surveys. To effectively manage the lake trout resource, it is necessary to establish the physiological requirements for lake trout and then predict the effects of increased nutrient loadings on water quality .

Data have not been collected over a sufficient time period for trend through time analysis, therefore an empirically-derived model was developed to predict the volume of water available as optimal lake trout habitat.

The chlorophyll concentration in the surface water can be used to quantify an organic load to the bottom water or hypolimnion. When the ***mixing ratio***, the surface water volume divided by the hypolimnion volume, is multiplied by the mean summer chlorophyll concentration, the potential chlorophyll concentration in the hypolimnion is determined. For a given lake, the greater the organic load the hypolimnion receives, the greater the demand for oxygen and subsequently the greater the loss in volume of water suitable to manage for lake trout.

Lakes with a small mixing ratio, that is a small surface water volume and a large hypolimnion volume, act to dilute or reduce the concentration of organic matter as it settles into the hypolimnion. Lakes with a large mixing ratio concentrate chlorophyll in the hypolimnion and therefore have a greater oxygen demand per unit volume.

The relationship between chlorophyll biomass in the surface water, the mixing ratio and available optimal lake trout habitat for the standardized date can be determined through regression analysis. The predictive capability of the model is adversely affected by lakes with a complex morphometry, lakes with ***metalimnetic minima***, and lakes which are ***meromictic***.

Using the data for 34 lakes which have the most suitable physical, biological, and chemical parameters with which a model could be developed, the product of the mixing ratio and mean summer chlorophyll was regressed against the optimal habitat expressed as a percent of the total lake volume. The line of best fit for the data is described by the equation:

$$\%\ OH = 54.1958 + \left[-59.5319 \log_{10}\left\{Chl\underline{a} \times \frac{V_O - V_H}{V_H}\right\}\right]$$

$$r^2 = 0.86$$

where:

% OH	is the optimal lake trout habitat expressed as a percent of the total lake volume
Chl<u>a</u>	is the mean summer chlorophyll <u>a</u> concentration
V_O	is the total lake volume
V_H	is the hypolimnion volume
$V_O - V_H$	is the surface water volume
$\frac{V_O - V_H}{V_H}$	is the mixing ratio.

This model predicts optimal habitat for a range of lake types based on chlorophyll concentrations and mixing ratios. The chlorophyll <u>a</u> concentration, surface water volume, hypolimnion volume, mixing ratio, measured percent optimal lake trout habitat and the predicted percent optimal lake trout habitat for the 53 lakes are summarized in Table 6.

TABLE 6
MEASURED AND PREDICTED OPTIMAL HABITAT AS A PERCENTAGE OF TOTAL VOLUME

LAKE	YEAR	TOTAL LAKE VOLUME V_0 x $10^6 m^3$	HYPOLIMNION VOLUME V_H x $10^6 m^3$	SURFACE WATER VOLUME $V_0 - V_H$ x $10^6 m^3$	MIXING RATIO $\frac{V_0 - V_H}{V_H}$	MEAN SUMMER CONC. Chla µg/L	MEASURED % OPTIMAL HABITAT	PREDICTED % OPTIMAL HABITAT
Ashby	1976	30.840	7.610	23.230	3.053	1.2	19	21
Ashden (Ashby White)	1976	13.690	3.250	10.440	3.212	1.8	16	9
Barker	1976	22.110	10.710	11.400	1.064	1.4	45	44
Barnard *	1982	7.350	3.600	3.750	1.042	1.7	22	39
Big Clear	1981	34.270	18.171	16.099	0.886	1.3	44	50
Big Ohlmann	1980	6.570	3.780	2.790	0.738	2.3	8	41
Big Rideau	1990	713.449	357.072	356.377	0.998	2.4	39	32
Big Salmon	1981	22.900	9.550	13.350	1.398	1.7	34	32
Birch	1975	34.000	16.555	17.445	0.949	2.4	23	33
Bobs (Green Bay)	1990	61.508	17.472	44.036	2.520	2.6	9	6
Buck (N. Basin)	1987	28.299	7.571	20.658	2.729	2.8	0	0
Buck (S. Basin)	1979	60.990	22.851	38.139	1.669	2.3	12	19
Canoe	1975	66.690	37.850	28.840	0.762	1.8	45	46
Charleston	1981	433.500	208.800	224.700	1.076	3.0	48	24
Crow	1981	59.750	21.270	38.480	1.809	1.8	21	24
Crystal *	1982	4.690	1.590	3.100	1.950	1.0	38	37
Desert	1975	81.100	43.980	37.120	0.844	2.6	32	34
Devil	1975	152.200	65.378	86.822	1.328	2.3	29	25
Dickey	1976	37.930	20.710	17.220	0.831	1.0	58	59
Eagle	1975	83.880	29.570	54.310	1.857	2.3	19	17
Effingham	1976	18.470	4.720	13.757	2.915	2.0	15	9
Fox	1981	3.446	1.246	2.200	1.766	2.0	21	22
Gould	1987	39.939	22.423	17.516	0.781	1.1	58	58
Grimsthorpe	1985	7.342	2.174	5.168	2.377	3.4	0	0
Hungry	1976	18.540	4.740	13.800	2.911	3.6	0	0
Joeperry	1976	12.350	2.740	9.610	3.507	1.7	0	8
Kishkebus	1976	11.430	4.460	6.970	1.563	2.2	16	22
Knowlton	1975	27.830	10.730	17.100	1.594	1.9	23	26
Little Green	1980	3.495	1.086	2.409	2.218	1.7	19	20
Little Mackie (Camp)	1981	6.342	2.470	3.872	1.568	1.6	31	30
Long Mallory	1976	4.970	1.128	3.842	3.406	1.3	11	16
Loughborough (W. Basin)	1989	109.045	37.897	71.148	1.877	3.1	0	0
Loyst	†	2.274	†	†	†	†	†	†
Lucky	1976	11.820	4.120	7.700	1.869	2.2	14	18
Mackie	1976	13.740	2.719	11.021	4.052	2.4	5	0
Mazinaw *	1971	684.900	543.600	141.300	0.260	1.2	79	84
Mosque	1976	10.204	1.978	8.226	4.159	1.9	0	1
Murray	†	2.286	†	†	†	†	†	†
Otter (Cotter)	1976	26.310	7.440	18.870	2.536	1.5	31	20
Palmerston	1980	115.900	63.160	52.740	0.835	1.4	53	49
Potspoon	1979	7.297	2.213	5.084	2.297	1.6	0	0
Rainy	1985	4.278	1.149	3.129	2.723	2.2	0	4
Red Horse	1981	30.620	11.900	18.720	1.573	5.2	0	0
Reid	1976	8.090	1.490	6.600	4.415	1.6	0	4
Round Schooner	1976	28.860	12.740	16.120	1.265	2.1	32	29
Shabomeka	1976	33.990	11.380	22.610	1.987	1.8	27	21
Sharbot (W. Basin)	1979	63.829	15.377	48.452	3.151	2.2	8	4
Silver	1979	25.342	7.462	17.880	2.396	2.6	0	7
Simpson	1982	2.652	0.901	1.751	1.943	1.8	12	22
Thanet	1976	8.760	1.670	7.090	4.246	1.6	4	5
Trout (Len) *	1978	22.910	10.630	12.280	1.156	1.5	20	40
Wensley (Brule)	1976	126.300	70.570	55.730	0.697	1.6	56	51
Weslemkoon	1976	168.700	47.000	121.700	2.589	1.4	27	21

† no water quality data available ** not standardized data (based on best estimate)*

Application of the Model

A model can be used as a planning tool by allowing for a change in one or more variables and then predicting the resulting impact of that change. Lake models have been used to predict the effects of nutrient loading on phosphorus concentration and in turn the effects of phosphorus concentration on chlorophyll concentration[26]. The model described in the preceding section allows for subsequent prediction of the impact on optimal lake trout habitat resulting from a change in chlorophyll concentration.

The use of these models in a step-wise fashion allows for the prediction of the effects of a change in nutrient supply on optimal lake trout habitat.

The relative sensitivity of a group of lakes to a 100 kilogram unit increase in phosphorus supply can be determined by ranking them according to the predicted increase in phosphorus concentration and chlorophyll concentration.

By extending the above procedure, the model can be used as a tool to predict the sensitivity of a lake to loss of optimal lake trout habitat, in terms of suitable water volume, resulting from the increase in chlorophyll a.

The sensitivity of the lake to loss of optimal lake trout habitat is determined as the absolute loss in water volume optimal for lake trout expressed as a percent of the total lake volume. The ranking of a group of lakes according to their predicted absolute loss in percent optimal volume allows for a lake to lake comparison of the relative sensitivities.

The above procedure allows for the classification of the lakes according to their sensitivity to loss of optimal lake trout habitat.

It is imperative that protection from nutrient loading be provided to those lakes in which optimal habitat will be impacted the greatest by a nutrient increase. It is also imperative to provide protection to those lakes which can ill afford to lose any additional optimal habitat.

Calculating the percentage change in optimal habitat between that predicted under present conditions and that predicted after a 100 kilogram unit increase in phosphorus supply allows for a ranking of the potential to impair the remaining optimal habitat. The sensitivity index contains a range in possible values from 0% (no loss in optimal habitat) to 100% (complete loss in optimal habitat) change. The model can predict values greater than 100% change. Where greater than 100% change is predicted, the sensitivity is recorded as 100%+.

For management purposes, lakes are grouped into two classes of sensitivity to impairment of their optimal lake trout habitat. Lakes experiencing greater than a 50% change are classed as Highly Sensitive; lakes experiencing a change equal to or less than a 50% change are classed as Moderately Sensitive.

Table 7 ranks 53 lakes managed for lake trout according to their predicted percentage change in optimal habitat.

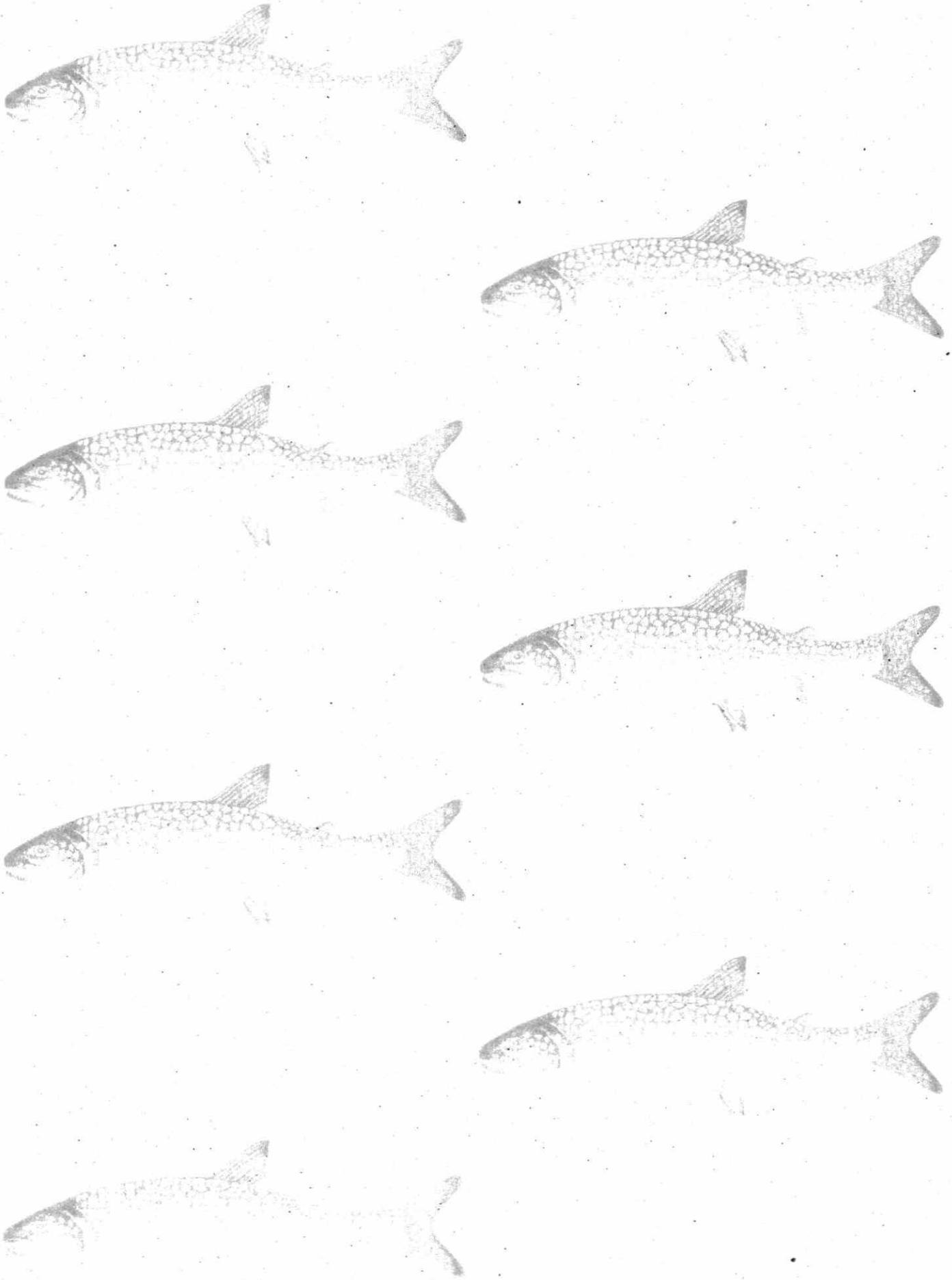
26 For example, Dillon, 1975; Dillon and Kirchner, 1975; Dillon and Rigler, 1974; Dillon and Rigler, 1975; Dillon, Nicholls et al., 1986; Hutchinson, Neary and Dillon, 1991.

TABLE 7
MANAGED LAKE TROUT LAKES RANKED ACCORDING TO PREDICTED PERCENTAGE CHANGE IN OPTIMAL HABITAT

LAKE	SAMPLING YEAR	MEASURED % OPTIMAL HABITAT (AUG. 31)	PREDICTED % OPTIMAL HABITAT (AUG. 31)	PREDICTED % OPTIMAL HABITAT WITH A 100kg P INCREASE	SENSITIVITY INDEX
HIGHLY SENSITIVE					
Rainy	1985	0	3	0	100+
Simpson	1982	15	22	0	100+
Mosque	1976	0	1	0	100+
Fox	1981	21	22	0	100+
Little Green	1980	19	20	0	100+
Little Mackie (Camp)	1981	31	30	0	100+
Potspoon	1979	0	0	0	100+
Grimsthorpe	1985	0	0	0	100+
Red Horse	1981	0	0	0	100+
Reid	1976	0	4	0	100+
Thanet	1976	4	5	0	100+
Crystal*	1982	38	37	0	100+
Ashden (Ashby White)	1976	16	9	0	100+
Joeperry	1976	0	8	0	100+
Mackie	1976	5	0	0	100+
Lucky	1976	14	18	0	100+
Barnard*	1982	22	39	0	100+
Long Mallory	1976	11	16	0	100+
Big Ohlmann	1980	8	41	0	100+
Effingham	1976	15	9	0	100+
Kishkenbus	1976	16	22	0	100+
Hungry	1976	0	0	0	100+
Silver	1979	0	7	0	100+
Buck (N. Basin)	1987	0	0	0	100+
Loughborough (W. Basin)	1989	0	0	0	100+
Sharbot (W. Basin)	1979	8	4	1	75
Big Salmon	1981	34	32	9	72
Bobs (Green Bay)	1990	9	6	2	66
Ashby	1976	19	21	9	57
Shabomeka	1976	27	21	9	52
Loyst	†	†	†	†	†
Murray	†	†	†	†	†
MODERATELY SENSITIVE					
Knowlton	1975	23	26	15	42
Trout (Len)*	1978	20	40	24	40
Round Schooner	1976	32	29	18	38
Canoe	1975	45	46	30	35
Big Clear	1981	44	44	29	34
Barker	1976	45	44	30	32
Otter (Cotter)	1976	31	20	14	30
Eagle	1975	19	17	12	29
Gould	1987	57	58	46	26
Birch	1975	23	33	25	24
Buck (S. Basin)	1979	12	19	15	21
Desert	1975	32	34	27	21
Crow	1981	21	24	19	21
Dickey	1976	58	59	52	12
Wensley (Brule)	1976	56	51	46	10
Weslemkoon	1976	27	21	19	10
Palmerston	1980	53	49	44	10
Devil	1975	29	25	23	8
Charleston	1981	48	24	23	4
Big Rideau	1990	39	32	31	3
Mazinaw*	1971	79	84	83	1

† no water quality data available to rank; included in Highly Sensitive class based on morphometric characteristics

** not standardized data (based on best estimate)*



Management Direction

Lake trout management is an integral component of the overall fisheries management program. This section defines general guidelines and strategies for the management of the lake trout resource in southeastern Ontario. On a more local level, specific management tactics and activities are outlined in Ministry of Natural Resources' district fisheries management plans.

Manageable populations of lake trout and their aquatic environment will be protected and maintained to ensure the continued existence of the resource. A satisfactory angling experience will be sought by making optimum use of the natural potential yield capacity of each waterbody.

Fisheries management decisions will be based on an assessment of individual and representative lakes to determine actions that will maintain or improve habitat and fish populations.

MANAGEMENT STRATEGIES

Many simultaneous management actions are required to effectively manage the inland lake trout resource base of southeastern Ontario. Many of the actions already are being carried out within current management capability. Others can be implemented through the realignment of present staffing and/or funding levels.

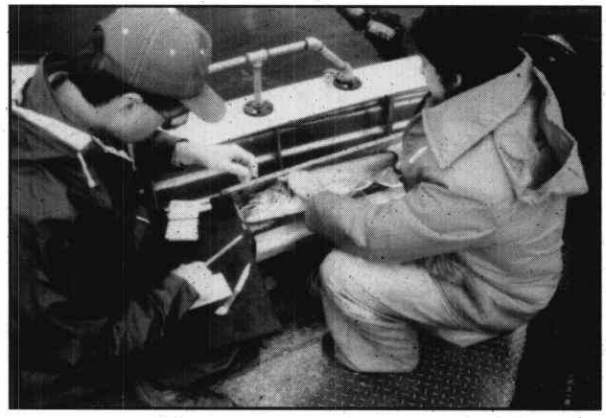
Management activities have been compiled and organized under the broad headings: Fisheries Assessment; Habitat Management; Fish Stocking; and Harvest Management. The detailed management activities associated with each item are identified in a step-down fashion.

Fisheries Assessment

Purpose

Two levels of fisheries assessment are undertaken on inland lake trout lakes in southeastern Ontario, Intensive studies on a small number of selected waterbodies are carried out by the Rideau Lakes and the Haliburton-Hastings Fisheries Assessment Units.

Fisheries assessment programs are carried out by MNR biologists to monitor the status of local lake trout populations



Ministry of Natural Resources Photo

The provincial fisheries assessment unit system was founded on the concept that different water bodies with the same fish community respond similarly when confronted by stresses such as over-exploitation, water level fluctuations, acidification, nutrient enrichment, shoreline alteration and exotic species introduction. The role of fisheries assessment units is to provide "intelligence" for fisheries management decisions by the collection, analysis, interpretation and

comparison of trend through time data series for representative lakes and major fish communities throughout the province. Lake trout is one of six fish species selected for study.

On a broader scale, the fisheries on remaining inland lake trout lakes have been monitored through joint aerial and ground surveys coordinated by the former Eastern Region of the Ministry of Natural Resources. These annual surveys (1989-92) were designed to monitor winter/open water angling activities on a broad geographic (angling division) basis. Additional programs, such as index netting projects, also are carried out by district/area staff on an ongoing basis.

Fisheries Assessment in Southeastern Ontario

Six inland lake trout lakes in southeastern Ontario are designated as ***type*** lake trout ***lakes.*** The Rideau Lakes Fisheries Assessment Unit is studying Big Clear, Big Rideau, Big Salmon, Charleston and Devil Lakes while the Haliburton/ Hastings Unit monitors Dickey Lake.

Assessment unit data are essential to evaluate the response of lake trout fisheries to any management initiative. The Ministry of Natural Resources is committed to the continued operation of fisheries assessment units.

The collection of fisheries data on non-assessment unit lakes also is an important management activity. Lake specific information is required to apply fisheries intelligence gathered on assessment unit type lakes. In addition, site specific habitat information is required for plan input and review as well as enforcement of fish habitat legislation.

Management Activities

- Maintain Rideau Lakes Fisheries Assessment Unit operations to secure baseline and trend information on its five lake trout lakes.
  - ♦ Within available funding levels, implement the Rideau Lakes Fisheries Assessment Unit five year operating plan to monitor the status of fish communities, user characteristics, harvest and environmental parameters.
  - ♦ Ensure timely transfer of fisheries information from the Rideau Lakes Fisheries Assessment Unit to management staff.
- Carry out experimental management projects on the lakes being studied by the Rideau Lakes Fisheries Assessment Unit.
  - ♦ Significantly reduce or eliminate stocking to determine response of native lake trout populations.
  - ♦ Close selected lakes to lake trout angling and compare to lakes having no angling restrictions.
  - ♦ Conduct stocking utilizing eyed eggs and local "native" strains of lake trout.
- Increase accuracy of predictions and understanding about southeastern Ontario lake trout lakes by the collection of additional data on non-assessment unit lakes.
  - ♦ Continue an annual aerial creel survey to monitor changes in angling activity and associated harvests.
  - ♦ Initiate index fishing projects on individual lakes according to provincial standards and guidelines[27].
  - ♦ Develop a central repository on inland lake trout information, including historic records on population status and utilization.

27 Lester et al., 1991.

Habitat Management

Purpose

The purpose of habitat management is to ensure the maintenance, rehabilitation and preservation of fish habitat.

Lake trout are a highly specialized species and have very specific habitat requirements. They are unable to adapt to significant changes in their environment. It is necessary to prevent any further deterioration of water quality parameters essential for the survival of lake trout and to upgrade water quality conditions where feasible.

With reference to the classification of lake sensitivity to increased nutrient supply as adopted in this report, existing volumes of water suitable for management of lake trout will be preserved in Highly Sensitive lakes and loss of suitable water volume to manage lake trout will be minimized in Moderately Sensitive lakes.

The habitat requirements of lake trout are complex. In simplest terms, lake trout require habitat in which they can complete their life cycle and reproduce. However lake trout habitat requirements also vary among stages in the life cycle of the lake trout. As such, lake trout habitat requirements vary both in time and space necessitating good knowledge of local conditions if these requirements are to be recognized and protected.

Authority to Protect Fish Habitat

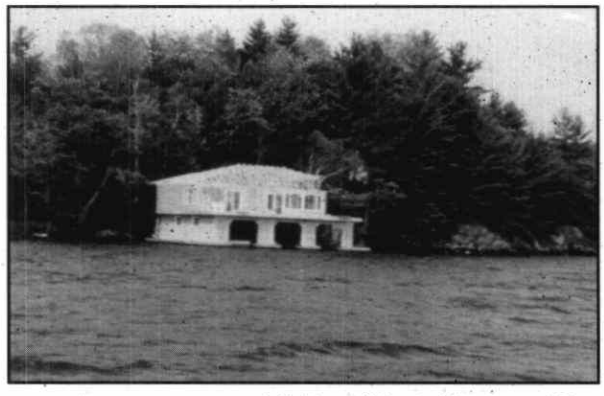
Legislative authority to protect fish habitat is contained in the *Fisheries Act* (Canada). This Act is jointly administered in Ontario by the Ministry of Natural Resources and the Ministry of the Environment. Section 31 prohibits " . . . any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat".

The Federal government's long-term policy objective is an overall net gain of the productive capacity of fish habitat. This objective will be attained by applying the "no net loss" concept as a guiding principle in order to maintain the current productive capacity of fish habitat.

The Threats to Lake Trout Habitat

Lake trout habitat can be damaged in ways both obvious and subtle and by changes both large and small[28]. The attractive pristine waters of oligotrophic lake trout lakes have attracted various types of shoreline development activities and different user groups which have the potential to degrade lake trout habitat in a variety of ways.

Shoreline development often results in harmful alterations to fish habitat and a deterioration in water quality



Ministry of Natural Resources Photo

The most common threats to lake trout habitat include:

- increased nutrient loading of lakes which reduces dissolved oxygen levels, increases the

28 see Evans et al., 1991a and 1991b.

abundance of aquatic vegetation and results in the deposition of organic material on spawning grounds;

- increased silt loading to lakes resulting in a great accumulation of inorganic sediment;

- artificial manipulation of water levels resulting in either drowning or exposing spawning grounds, warming water temperature profiles and increasing nutrient silt loading; and

- direct disturbance of spawning grounds by such activities as dredging, infilling and the removing of substrate material for piers and retaining wall construction.

Legal authority dealing with these matters is shared by several agencies each with its own specific mandate. Successful lake trout management, therefore, must be implemented in concert with other governing bodies and requires broad public support.

Management Activities

- Implement specific policies and procedures as detailed in the Land Use and Development Strategies section of this report designed to preserve existing lake trout habitat in highly sensitive lakes and to minimize habitat loss in less sensitive lakes.

- Participate in planning activities of municipal and provincial government agencies whose activities affect lake trout communities.

- Maintain or improve lake trout spawning shoals.

    - Document the location of active or potential lake trout spawning shoals and evaluate limiting factors affecting the suitability of shoals to support spawning activity.

    - Protect spawning shoals from damage through dredging, filling or dock construction by enforcing appropriate legislation, such as the *Lakes and Rivers Improvement Act*, the *Public Lands Act* and the *Fisheries Act*.

    - Improve existing spawning shoals by depositing suitable substrate where the quality or quantity of available substrate may be a limiting factor.

    - Clean silted spawning shoals by washing with high pressure hoses.

    - Determine the effects of nutrient enrichment on lake trout spawning shoals.

- Negotiate with appropriate agencies the implementation of water regimes on lake trout lakes that are favourable to lake trout spawning, egg incubation, and spawning shoal cleaning.

- Develop and implement measures to reduce phosphorus inputs from existing development and land use activities with emphasis on the Highly Sensitive lakes.

- Continue a program of lake surveys to expand information on the current water quality status of lake trout lakes and to monitor changes in water quality in relation to lake trout requirements.

- Develop and refine lake water quality models to improve the capability of predicting effects of nutrient supply on lake trout habitat.

- Evaluate levels of inorganic and organic contaminants in lake trout populations and assess sources and factors affecting the rates of accumulation.

Fish Stocking

Purpose

Lake trout are stocked in inland waters in southeastern Ontario for one of two purposes:

Supplemental. Stocking of lake trout into a water body to increase the resident population beyond the present capacity for self-recruitment.

Put-Grow-and-Take. The introduction of lake trout into a waterbody when there is no intention or likelihood of natural reproduction occurring in order to provide short term angling opportunities.

The objective in each case is to provide artificial fishing opportunities. The term ***artificial*** is used to distinguish fishing opportunities dependent upon fish stocking from an opportunity derived from a ***self-sustaining*** population of fish.

Management Concerns with Lake Trout Stocking

The stocking of lake trout has been a traditional management approach in southeastern Ontario for many years and is often regarded as a "cure-all" solution for impaired lake trout populations. However, this management technique offers only minimal benefit to the over-all lake trout management program and under certain circumstances may damage reproducing lake trout populations.

As natural reproducing lake trout stocks decline due to overharvest or environmental degradation, fish stocking may improve fishing success. This results in the illusion that the natural system is not impaired; whereas the original population may have seriously declined or disappeared gradually through the years.

Lake trout stocking also appears to add harvest pressure. Many anglers are attracted to stocked lakes, believing that the fishing will be better because of the stocking activity. Since angling is non-selective, removing both native and stocked fish, any harvest pressure added because of stocking places additional harvest pressure on the native fish stocks, often at a time when they cannot sustain additional stress because of existing overharvest situations.

There is a concern with respect to the genetic effect of hatchery lake trout surviving to reproduce and mix with native lake trout. Recent evidence suggests that native stocks are best suited for the specific habitat in which they live[29]. On the other hand, hatchery reared fish may possess a very different genetic make up. Mixing genetically dissimilar types of lake trout can result in degradation of the native gene pool which may seriously jeopardize the survival value of the resulting progeny [30].

A Redefined Role for Lake Trout Stocking

The emphasis on stocking lake trout lakes having significant natural reproduction has been evaluated, taking into consideration concerns about added harvest pressure, the non-selective nature of harvest and the potential impacts of genetic inbreeding[31].

As a result of the evaluation, the primary role of lake trout stocking will be to supply artificial angling opportunities in holding basin lake trout lakes with good potential for rehabilitation. Stocking lake trout lakes with significant natural reproduction will be de-emphasized and as native lake trout populations recover in response to

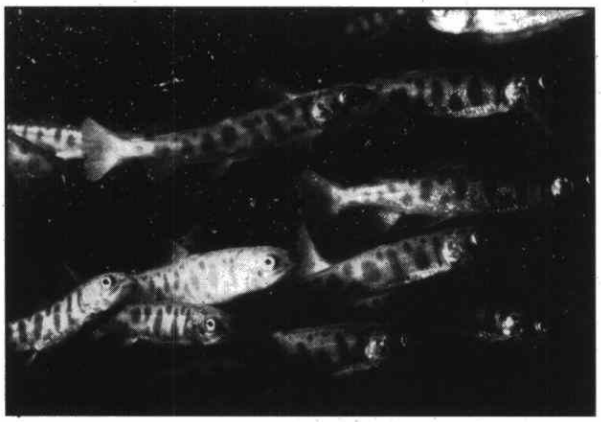
29 MacLean et al., 1990.

30 MacLean et al., 1990; Evans et al., 1991b.

31 see Olver et al., 1991.

other management actions, lakes with significant natural reproduction will receive progressively less stocking.

Fish stocking programs, particularly in those lakes supporting naturally reproducing stocks, will be reduced



Ministry of Natural Resources Photo

Alternative Coldwater Fisheries

In addition to lake trout, the Ministry of Natural Resources stocks splake, rainbow trout and brook trout in inland waters to supply fishing opportunities on a put-grow-and-take basis.

F1 splake will have a major role to play in lake trout management by supplying alternative fishing opportunities.

Splake are intermediate in their preferred temperatures; preferred temperatures for lake trout and brook trout can be considered as 10°C and 16°C respectively. Splake have a temperature preference of approximately 12°C.

The proposed stocking program for splake includes converting lakes difficult to manage as put-grow-and-take lake trout fisheries. In addition, splake will be introduced into entirely new lakes having less than favourable conditions for lake trout but suitable conditions for splake as well as converting some put-grow-and-take brook trout and rainbow trout fisheries. With a longer open season and higher catch and possession limits, it is hoped that splake will divert pressure away from lake trout fisheries.

Research studies have demonstrated that splake provide significantly higher returns than stocked lake trout, brook trout, or rainbow trout in certain inland lakes. Recent studies have indicated that angling quality and recorded yields of splake are two to three times greater than that of lake trout[32].

Table 8 shows a list of lakes designated for splake management. The *Class Environmental Assessment for Fish Stocking in New Waters* is applied to each initial introduction of splake. The F1 splake stocking program commenced in 1983 with the release of approximately 6,000 fish in five lakes. Currently, 25 to 30 southeastern Ontario inland lakes are stocked with 100,000 fish annually. Future stocking of this species will depend on a thorough evaluation of their survival, growth and contribution to the fishery.

Certain lakes in southeastern Ontario will be managed for other coldwater fisheries and receive brook trout, rainbow trout or brown trout stocking rather than lake trout or splake. These lakes exist primarily in the northern part of Frontenac County and were established to provide a diversity of angling opportunities. The management objective is to maintain these fisheries as put-grow-and-take, with little likelihood of establishing self-sustaining populations.

Once again the concept will be to provide a diversity in angling opportunities which will hopefully draw fishing pressure away from self-sustaining inland lake trout fisheries in southeastern Ontario.

32 Kerr, 1992.

In 1991, 67,500 brook trout, 19,300 rainbow trout and 11,100 brown trout were stocked. Lakes designated for management of these species are identified in Tables 9 and 10.

TABLE 8
LAKES DESIGNATED FOR SPLAKE MANAGEMENT BY MNR OFFICE

BROCKVILLE	CARLETON PLACE	NAPANEE	TWEED
Indian	Brookes	Cronk	Big Mair
Otter	Davern	Doe	Brooks
Lower Beverley	Farren	Dog (NE Basin)	Cranberry
	Napier	Draper	Egg
	Perch	Garter	Elzevir
	Round	Leo	Granite
		Little Clear	Grindstone
		Little Salmon	Labine
		Thirty Island	Limi
		Upper Rock	Little Long
		White	Little Yirkie
			Long Schooner
			Machesney
			McCausland
			Spring

TABLE 9
LAKES DESIGNATED FOR BROOK TROUT MANAGEMENT BY MNR OFFICE

BROCKVILLE	CARLETON PLACE	NAPANEE		TWEED	
Basin	Bottle	Clearwater	Bailey	Horseshoe	Rettans
Mud	Green	Moulton	Bear Mountain	Hungry*	Rock
	Dunks	Paddys	Big Birch	Kitchen	Rockcliffe
	Green	Tetsmine	Browns	Little Birch	Rose
	Little		Bullseye	Little Mosque	Ruby
	Minnow		Butternut	Lonewolf	Shoepack
	Peterwhite		Cedar	Longbay	Snowshoe
			Cranberry	Marshall	South Quinn
			Crankshaw	McCreary	Spot
			Croker	McDowell (Beyes)	Spring
			Eno	Minnow	Straddlebug
			Evelyn	Mousseau	Sullivan
			Feeney	North East	Thirty-eight
			Gibsons	North Quinn	Toor
			Grace Parkhurst	Nowlan	Triple
			Graham	Otter*	Twintoor
			Greggs	Payes	West Twinpines
			Hemlock	Raindrop	

* also managed for lake trout

TABLE 10
LAKES DESIGNATED FOR RAINBOW TROUT OR BROWN TROUT MANAGEMENT BY MNR OFFICE

TWEED	
Blakely	Little Round
Chouinard	Mair (Green)
Kilbourne	Quackenbush
King	Small Clear
Leatheroot	Wolfe

Management Activities

- Modify the inland lake trout stocking program taking into consideration concerns about harvest pressure, the non-selective nature of harvest and genetic inbreeding.

  - As native lake trout recover, reduce or eliminate lake trout stocking in lakes with significant natural reproduction.

  - Maintain or increase lake trout stocking levels in holding basin lake trout lakes.

  - Initiate studies to determine genetic integrity of local lake trout populations.

- Provide alternative coldwater species in suitable waterbodies.

  - Annually stock approximately 100,000 splake by converting some put-grow-and-take lake trout lakes and where appropriate, brook trout and rainbow trout lakes.

  - Annually stock approximately 60,000 brook trout in suitable waters.

  - Annually stock approximately 20,000 rainbow trout in suitable waters.

  - Annually stock 5-10,000 brown trout in suitable waters.

- Investigate the impacts of stocking on top of native natural reproducing lake trout populations.

  - Carry out experimental management projects on the lakes being studied by the Rideau Lakes Fisheries Assessment Unit.

Harvest Management

Purpose

The purpose of harvest management is to allocate the resource to optimize social and economic benefits without over-exploiting resident lake trout stocks.

In situations where the management objective is to maintain naturally self-sustaining fish populations, as is the case for the majority of lakes selected for lake trout management, controls must be effective in apportioning the limited resource between the resource itself (to allow for perpetuation and maintenance) and the different users (to provide for optimal recreational opportunities).

When the management objective is to supply artificial fishing opportunities, as is the case for lakes designated for splake fisheries, control also

must be effective in apportioning the limited resource. In these situations, the concern about resource perpetuation and maintenance does not exist in the same manner, however a fair and equitable distribution of the resource between the different users is a priority purpose for harvest management. Like the situation above, the objective is to provide for optimal recreational opportunities.

The diversion of angling pressure away from self-sustaining lakes can also be considered a harvest management objective when devising angling regulations for artificial fisheries.

Surveys of angling activity on lake trout lakes in Division 29 have been carried out during the four winters of 1989-92[33]. A similar survey was conducted during the 1991 open water season in Divisions 9, 10 and 29[34].

Between 1989 and 1992, winter angling pressure in Division 29, where the only ice fishery for lake trout exists, has ranged from 12,000 to 34,000 angler hours.

Corresponding winter harvests have varied from 1,000 to 3,200 fish weighing some 644 kg and 1 500 kg, respectively. In 1991, when both winter and open water surveys were carried out, winter angling pressure accounted for 34% of the annual fishing effort in Division 29.

In Divisions 9, 10 and 29 combined, the 1991 fishing pressure was estimated to be nearly 426,000 angler hours of effort.

It is recognized that angling pressure and harvests may vary substantially among lakes from year to year. Nevertheless, these recent data indicate that inland lake trout fisheries are still subject to relatively intense angling activity despite the introduction of shortened seasons. The popularity and variability of these fisheries adds to the complexity of their management.

Identification of Over-Exploitation

Over-exploitation is a condition whereby intensive angling effort, either past or present, has contributed to a decrease in yield . There is no one single biological measure short of collapse that is an absolute indicator of over-exploitation. There are however, several indices which taken together can provide a reasonable picture of the level of exploitation in a fishery. These indices are: relative yield, total mortality, mean age, growth rate and creel census statistics.

Relative Yield.

Researchers have found that the ***annual yield*** for all species in a lake can be estimated by the equation:

$$Y = 1.4 \left\{ \frac{TDS}{\bar{Z}} \right\}^{0.45}$$

where: Y = annual potential yield in kg/ha
TDS = total dissolved solids in µg/L
$\bar{Z}$ = mean depth in m

Lake trout are typically found in deep clear lakes and as a general rule, these lakes are relatively unproductive. Lake trout yield in healthy fisheries is usually around 25% of the potential yield for all species[35].

Relative yield indices provide a good first order indicator of over-exploitation. The relative yield index for a particular lake trout fishery can be calculated as follows:

33 Hoyle, 1989; Grant, 1990; Kerr, 1991a; Kerr, 1992.

34 Kerr, 1991b.

35 Ontario Ministry of Natural Resources, 1982.

$$RYI = \frac{\text{observed yield of lake trout}}{\text{recommended yield of lake trout}}$$

If the RYI is greater than one, there may be over-harvest. If the RYI is less than one the harvest is usually at acceptable levels. However, a RYI of less than one also could result from past over-exploitation.

Total Mortality.

This is the rate at which fish are lost to a fishery through both natural causes and fishing. For the maintenance of self-sustaining lake trout stocks and the rehabilitation of planted stocks, a total annual mortality of 45% is recommended to identify overharvest and serve as a criterion for establishing regulations[36].

Mean Age.

Lake trout in the Rideau Lakes area generally are capable of spawning for the first time in their fifth year. If the mean age at capture is less than five, then the majority of the fish will not have had the opportunity to spawn and the population will decline due to reduced reproduction.

Lake trout catches from heavily exploited lakes are comprised primarily of small, younger fish

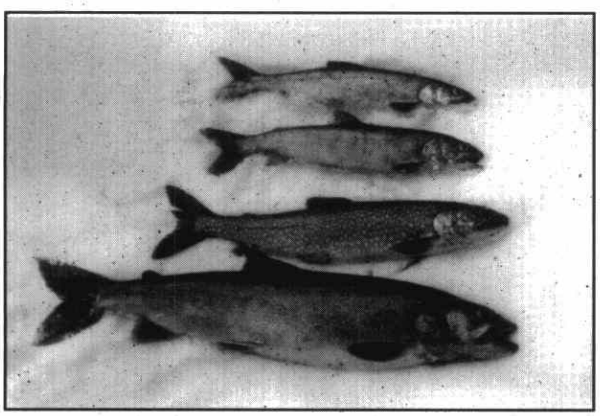


Photo by S.J. Kerr

Growth Rate.

Intensive exploitation of a fish population often results in accelerated growth because fish that are not caught have less competition for food and space. For comparative purposes, growth standards have been developed for lake trout. These standards are based on the average length at age for a large number of lake trout lakes. When length-at-age data for a particular lake are compared against the growth standard, a relative measure of accelerated growth can be determined.

Creel Census Statistics.

Creel census provides valuable information on fishing effort, harvest and the biological characteristics of the catch (mean age, weight, length, % stocked fish). The ratio of the catch to the effort expended is a valuable indicator of fishing success and species abundance. For a trophy lake trout fishery, a ***catch per unit effort (CUE)*** of 0.15 is usually acceptable.

Fish Population Response to Over-Exploitation

A general sequence of events takes place when a fish population is exploited. When angling first begins the effort initially expands, yield and success rates increase, while total mortality rate, growth rate and mean age remain relatively constant. As effort expands further and the population enters the early stage of over-exploitation, yield will continue to increase while CUE and the mean age decrease and total mortality and growth rate increase. In the intermediate stage of over-exploitation, yield reaches a peak and begins to drop off while CUE becomes increasingly more variable. Finally in the late stages of over-exploitation, yield, CUE and

36 Olver et al., 1991.

mean age all decrease substantially while total mortality rate and growth remain high. The relationship between yield, fishing effort, and abundance during stages in the development of a fishery are displayed in Table 11.

TABLE 11
RELATIONSHIP BETWEEN YIELD, FISHING EFFORT, AND ABUNDANCE DURING STAGES IN THE DEVELOPMENT OF A FISHERY

STAGE OF DEVELOPMENT	YIELD	FISHING EFFORT	ABUNDANCE
Very Early Stage	Low	Low	High
Early Stage	Intermediate	Low	High
Early Intermediate	Intermediate	Intermediate	Intermediate
Late Intermediate	High	High	Intermediate
Heavily Stressed	High	High	Very Variable
Recently Over-Stressed	Intermediate	High	Low
Late Stage	Low	Low	Low

Indices of over-exploitation from several southeastern Ontario lakes are presented in Table 12 and are described in the following assessments.

Big Clear Lake.

Relative yield indices, CUE, the increasing percentage of stocked fish in the harvest and the mean age of harvest all indicate that Big Clear Lake lake trout are over-exploited. Moreover, the trends in these indices suggest that the Big Clear Lake fishery may be in a transition phase from an early to intermediate stage of over-exploitation.

Big Rideau Lake.

Trends in yield and CUE seems to indicate that the lake trout fishery in Big Rideau Lake is relatively stable. However, the present fishing is supported heavily by stocking. Moreover, the mean age of harvest, total mortality rate and growth indices all suggest the fishery is in a stage of over-exploitation.

Charleston Lake.

Trends in relative yield indices, percentage of stocked fish, total mortality rate, mean age of harvest and growth indices all suggest over-exploitation. The present fishery also is supported heavily by stocking.

Devil Lake.

Relative yield, CUE, total mortality and growth indices indicate that the Devil Lake lake trout population is over-exploited. The relationship among these indices suggests that the fishery is in the early stages of over-exploitation.

Detailed information, such as presented in Table 12, is not available for all the lakes in southeastern Ontario. However, there are indications that a great majority of the lakes are in the early to intermediate stages of over-exploitation.

Application of the indices of over-exploitation results in the following findings:

- Lake trout yields exceed potential yield
- Total mortality exceeds 45%
- Mean age at harvest is less than mean age at sexual maturity
- Growth rate exceeds provincial norm
- The CUEs are decreasing
- The portion of hatchery fish in the anglers' creel is increasing.

TABLE 12
INDICIES OF OVER-EXPLOITATION FROM SELECTED SOUTHEASTERN ONTARIO LAKES

LAKE	YEAR	RYI[37]	TOTAL MORTALITY RATE		AMBROSOV[38] INDEX		FL-AGE[39]	CUE[40]		CATCH[41]		EFFORT[42]	
		T[43]	W	S	W	S	W	W	S	W	S	W	S
Big Clear (0.53)[44]	1981	3.70	0.47	ne[46]	0.4	1.5	= SGC	0.119	0.118	751	58	6322	535
	1982	[45]	0.24		0.4		> SGC	0.085		810		8896	
	1983	1.53	ne	ne	0.0	0.3	= SGC	0.084	0.104	442	12	4664	228
Big Rideau (1.01)	1981	0.97	ne	ne	-0.7	-0.7	>> SGC	0.187	0.185	3359	8069	20566	39989
	1982		0.37		-0.6		>> SGC	0.097		1832		18989	
	1983	1.05	ne	0.60	0.3	-0.6	>> SGC	0.108	0.231	2343	9717	22123	39235
Charleston (0.89)	1981	2.44	ne	0.65	-0.7	-0.7	>> SGC	0.240	0.130	3869	7474	16485	46322
	1982		0.62		-0.8		>> SGC	0.200		3101		11531	
	1983	4.53	0.45	0.52	-0.3	-0.4	>> SGC	0.257	0.140	8360	14496	25417	59082
Devil (0.87)	1981	3.86	0.63	0.47	-0.9	0.1	>> SGC	0.046	0.151	1453	2498	29022	12250
	1982		0.28		0.4		>> SGC	0.041		886		18778	
	1983	5.09	0.58	0.61	0.4	0.8	>> SGC	0.036	0.147	1533	2631	32199	16485

37 RYI: Relative yield index = estimated species yield / recommended species yield.

38 Abrosov, 1969.

39 FL-at-age: FL, fork length
SGC, standard growth curve
=, growth rate equivalent to SGC
>, slightly greater than SGC
>>, much greater than SGC.

40 CUE: Observed catch per unit effort expressed in fish per rod-hour.

41 Catch: Estimated total lake trout catch by all anglers.

42 Effort: Estimated total effort by anglers seeking lake trout (rod-hours).

43 Seasonal totals: T, total
W, winter
S, summer

44 Values in parentheses are the recommended maximum lake trout yields for each lake.

45 Blank denotes not sampled.

46 ne denotes not established.

Ontario Fisheries Regulations for Lake Trout

Authority.

Authority for regulating fisheries is derived from the *Fisheries Act*, RSC 1985, c.F-14. The pertinent section in that Act with respect to fishing regulations in Ontario is Section 43 (a) & (b). This section and associated sub-sections empower the Governor-in-Council to make regulations for the proper management and control of the sea coast and inland fisheries respecting the conservation and protection of fish.

Lake Trout Fishing Regulations.

In an effort to control angling pressure and associated lake trout harvest levels, the Ministry of Natural Resources has adjusted the lake trout season and possession limit no less than four times over the past 25 years. A summary of the previous and present regulations affecting lake trout in southeastern Ontario is provided in Table 13.

The changes that have occurred in lake trout fishing regulations over the past 25 years demonstrate the inconsistent approach of past regulatory efforts. The regulations were based on the subjective opinion on the part of the manager on what was fair in the contest between anglers and fish. This approach to lake trout harvest control is very traditional and relies on seasons, possession and creel regulations. These regulations are passive and indirect and do not control access or total harvest.

Therefore, more direct and biologically based criteria have been developed to assess harvest control options. The criteria are:

- mean age of harvest should be at least 7 years
- angler harvest should not exceed allowable yield, i.e. 25% of ***morphoedaphic index*** (MEI)
- total mortality rate should not exceed 45%.

These criteria, founded upon the recent Lake Trout Synthesis exercise, are believed to represent the best possible basis for harvest controls. In the future, lake trout harvest regulations will be evaluated against these criteria. The challenge will be to design regulatory schemes that allow for maximum recreation and do not exclude any participants while still meeting the biological objectives for sound resource management.

A series of new regulations are designed to reduce the overall lake trout harvest from local lakes

Rideau Lakes Fisheries Assessment Unit Photo

TABLE 13
SUMMARY OF PRESENT AND PREVIOUS REGULATIONS AFFECTING LAKE TROUT IN INLAND LAKES OF SOUTHEASTERN ONTARIO

YEAR	SEASON	DIVISIONS (POST 1966)			COUNTIES (PRE 1966)		CATCH AND POSSESSION LIMIT	BAIT RESTRICTIONS	NUMBER OF WINTER LINES
		7	9&10	29	Hastings, Frontenac Lennox & Addington	Leeds, Grenville, Lanark			
1989-1992	1st Saturday June to Sept.8		x				2	Div.29 — herring banned Div.10 — alewife or gizzard shad (live or dead) prohibited in Big Rideau, Charleston and Red Horse Lakes (Effective 1991)	2 (Div.7,9,10) 1 (Div.29)
	2nd Saturday March to Sept.8			x			2		
	Jan.1 - Oct.10	x					2		
1987-1988	1st Saturday June to Sept 8		x				3	Div.29 — herring banned	2 (Div.7,9,10) 1 (Div.29)
	2nd Saturday March to Nov.30			x			1 (March,April) 2 (May-Sept.)		
	Jan.1-Oct.10	x					3		
1981-1986	Jan.1-Oct.10	x					3	Div.29 — herring banned	2 (Div.7,9,10) 1 (Div.29)
	1st Saturday to 3rd Sunday Feb. and 1st Saturday June to Sept.8		x				3		
			x				3		
	2nd Saturday March to Sept.8			x			1 (Mar.-April) 2 (May-Sept.)		
1980	Jan.1-Oct.10	x					3		2
	1st Saturday to 3rd Sunday Feb. and 1st Saturday June to Sept.8		x				3		
			x				3		

YEAR	SEASON	DIVISIONS (POST 1966)			COUNTIES (PRE 1966)		CATCH AND POSSESSION LIMIT	BAIT RESTRICTIONS	NUMBER OF WINTER LINES
		7	9&10	29	Hastings, Frontenac Lennox & Addington	Leeds, Grenville, Lanark			
1974-1979	Jan.1-Oct.10	x					3		2
	2nd Saturday March to Sept.8		x				3		
1968-1973	Jan.1-Oct.10	x					5		2
	4th Saturday Feb. to Sept.30		x				Limit reduced to 3 in Div.10 from 1971-1973		
1966-1967	4th Saturday Feb. to Sept.30		x				5		2
1965	Last Saturday Feb. to Oct.4				x	x	2		5
1964	Last Saturday Feb. to Oct. 5				x		5		2
	Nov.6-Oct. 5					x			5
1958-1963	Mar.1-Oct.5				x		5		2
	Nov.6-Oct.5					x	Limit reduced to 3 from 1960-1962		

Ontario Fisheries Regulations for Alternative Coldwater Species

The diversion of angling pressure away from self-sustaining fish populations is a harvest management objective when considering angling regulations for artificial fisheries. In this regard, angling pressure will be diverted away from lake trout by supplying alternative coldwater fishing opportunities and instituting more liberal regulations such as longer seasons and larger possession limits. Particular emphasis will be placed on splake because it supplies a very similar angling experience. The other alternative coldwater species are rainbow trout, brown trout and brook trout.

Other species, such as the F1 splake, will be stocked to provide alternative angling opportunities

Ministry of Natural Resources Photo

Management Activities

- Control angler harvest on lakes designated as manageable lake trout lakes in a fashion to meet the biological harvest control objectives.

- Divert angler pressure away from manageable lake trout lakes by liberalizing the season and creel limits for splake.

- Maintain existing season and creel limits for brook trout and rainbow trout.

- Discourage inland lake trout derbies in southeastern Ontario.

  ♦ Request a voluntary moratorium on all inland lake trout derbies.

- Adjust enforcement priorities to effectively deter illegal harvest of lake trout.

  ♦ Increase angler contact on lakes designated as manageable lake trout lakes.

LAND USE AND DEVELOPMENT STRATEGIES

This section represents the land use component of the fisheries management and water quality strategy for the lake trout lakes of southeastern Ontario. Its purpose is to provide specific recommendations for land use and development control on the 53 lakes deemed manageable for lake trout, to ensure that optimal and/or usable habitat is maintained.

Much of the land surrounding these waters is publicly owned but there are large amounts of private land on many lakes. The maintenance of an available and environmentally suitable lake trout resource base demands an understanding of how it can be impacted upon adversely. Also required is the cooperation of other agencies, municipalities and an informed public.

Impact of Shoreline Development on Lake Trout Habitat

As described in previous sections, the degradation of the lake trout resource base can be largely attributed to excessive lake trout harvest, conflicts among user groups, and loss of lake trout habitat. Although shoreline development has an influence on all of these problem areas, its greatest impact is related to the loss of habitat.

A detailed account of how habitat loss occurs is provided in the water quality section; however, the following is an outline of how this habitat loss is affected by shoreline development.

Disturbances to vegetation and the natural soil cover caused by the construction of buildings, roads, and sewage disposal systems create unprotected soil which erodes into the lake carrying soil bound nutrients with it. In addition, conventional septic tank systems dispense nutrients into the soil which will reach the lake once the nutrient adsorption capacity of the soil is surpassed.

The type of vegetative cover also influences the rate at which nutrients reach the water in both surface runoff and groundwater flows. Natural vegetation is effective in minimizing erosion and intercepting nutrients. Lawn fertilization can increase nutrient loading to the lake and should be discouraged.

Nutrient enrichment of the lake water stimulates the growth of algae and other aquatic plants which eventually decompose using up oxygen in the process. The optimal and usable lake trout habitat decreases proportionately as the percentage of total lake volume with high temperature and low oxygen level increases.

In addition to the impact on lake trout habitat due to development on the shore, any dredging, filling or other disturbance to the ***littoral zone*** (i.e., near-shore shallows) can result in the resuspension of nutrients from the lake's sediments and/or direct physical damage to spawning and nursery areas.

Assessing Development Proposals

The Ministry of the Environment and the Ministry of Natural Resources have jointly established procedures for handling shoreline development as it relates to water quality and the lake's continued ability to support a fish community.

The two ministries confer on their respective fisheries and water quality concerns whenever they participate in the planning and development activities of other agencies, municipalities and the private sector.

Comments on planning documents and development proposals with respect to fisheries are guided by the following principles:

- critical fish habitat should be protected from the impact of incompatible land uses;
- land management and planning practices should be encouraged which eliminate or minimize any negative effects on fish habitat;
- all development should be designed and constructed in a manner that minimizes potential negative impacts on fish habitat; and
- wherever feasible, public access to fishery resources should be encouraged.

The 53 lakes in southeastern Ontario identified as manageable for lake trout qualify as critical fish habitat since they are considered essential to the achievement of a balanced fishery program objective. As described in previous sections, these lake trout waters have been assessed for their optimal and usable lake trout habitat and ranked according to their inherent ability to withstand nutrient inputs (Table 7). Grouping these waters into two levels of sensitivity to change in optimal habitat provides a practical guide for effective management to ensure the perpetuation of the lake trout resource.

The specific assessment of each lake is provided in Appendix B. The lakes are listed alphabetically by sensitivity class in Table 14.

TABLE 14
HABITAT SENSITIVITY OF MANAGED LAKE TROUT LAKES IN SOUTHEASTERN ONTARIO

CLASS	LAKE NAME	TOWNSHIP
Highly Sensitive	Ashby	Ashby
	Ashden (Ashby White)	Ashby
	Barnard	Ashby
	Big Ohlmann	Miller
	Big Salmon	Bedford, Loughborough
	Bobs (Green Bay)	Bedford
	Buck (N. Basin)	Bedford, Loughborough
	Crystal	Ashby
	Effingham	Effingham
	Fox	Ashby
	Grimsthorpe	Grimsthorpe, Anglesea, Effingham
	Hungry	Olden
	Joeperry	Effingham
	Kishkebus	Barrie
	Little Green	Clarendon
	Little Mackie (Camp)	Miller
	Long Mallory	Abinger
	Loughborough (W. Basin)	Loughborough, Storrington, Kingston
	Loyst	Sheffield
	Lucky	Miller
	Mackie	Miller
	Mosque	Clarendon, Miller, South Canonto
	Murray	Darling
	Potspoon	Bedford
	Rainy	Effingham
	Red Horse	Rear Leeds & Lansdowne
	Reid	Miller, South Canonto
	Shabomeka	Barrie
	Sharbot (W. Basin)	Olden, Oso
	Silver	Oso, South Sherbrooke
	Simpson	Ashby
	Thanet	Lake

CLASS	LAKE NAME	TOWNSHIP
Moderately Sensitive	Barker	Ashby
	Big Clear	Bedford
	Big Rideau	North Burgess, South Burgess, North Elmsley, South Elmsley, Bastard, North Crosby
	Birch	Bedford
	Buck (S. Basin)	Bedford, Loughborough, Storrington
	Canoe	Bedford
	Charleston	Rear Leeds & Lansdowne, Rear Yonge & Escott, Front Leeds & Lansdowne, Front Escott
	Crow	Bedford, Oso
	Desert	Bedford, Loughborough
	Devil	Bedford
	Dickey	Lake
	Eagle	Olden, Hinchinbrooke
	Gould	Loughborough
	Knowlton	Loughborough
	Mazinaw	Abinger, Barrie
	Otter (cotter)	Ashby
	Palmerston	Palmerston, South Canonto
	Round Schooner	Miller
	Trout (Len)	Ashby
	Wensley (Brule)	Miller
	Weslemkoon	Ashby, Effingham, Cashel

Practical Actions

The following actions largely reaffirm the recommendations contained in the *Report on Water Quality Management of the Lake Trout Waters of Southeastern Ontario,* 1977 and Volume II, 1980. They are not intended to replace any existing local planning policies which are more stringent, nor do they remove the necessity for site inspections by the various authorities involved in determining the suitability for development of any specific parcel of shoreline property.

The intent is to control phosphorus inputs to the sensitive lakes and to prevent irreversible degradation of the near-shore shallows (littoral zone), thereby maintaining the habitat necessary for the survival of lake trout.

Any landowner affected by this management approach is encouraged to contact the offices of the ministries of Environment and Natural Resources. Advice will be provided on possible alternatives to conventional shoreline development that may still satisfy the management intent.

THE FOLLOWING ACTIONS ARE RECOMMENDED FOR ALL 53 LAKES MANAGED FOR LAKE TROUT (HIGHLY AND MODERATELY SENSITIVE CLASSES).

- All property owners are encouraged to form a single association for each lake to promote self-help programs that will assist in maintaining a quality lake environment.

Information pertaining to such programs can be obtained from the offices of the two ministries listed at the back of this report.

- All property owners with private waste disposal systems are encouraged to voluntarily contact the Health Unit for assistance in determining whether their system meets current standards and, if not, how their system could be upgraded in the interest of water quality protection.

It is particularly important for health reasons that substandard systems which may be contributing bacteria to the lake be upgraded. It is also important, on all lake trout lakes to improve substandard systems in order to assist in protecting the lake trout population.

- All property owners are encouraged to minimize phosphorus inputs to lakes by:

  - reducing the quantity of water utilized for domestic purposes;

  - avoiding or minimizing the use of automatic dishwashers since these conveniences require a high phosphate content detergent;

  - avoiding the establishment of a lawn adjacent to the water and the use of fertilizer on existing lawns; and,

  - avoiding or minimizing the removal of natural vegetation and planting trees and/or shrubs to increase the amount of vegetative cover on a lot, particularly in the area closest to the water.

Nutrient enrichment effects have been described in the section on water quality. Any efforts to limit the stresses of nutrient enrichment of lake trout waters will contribute to the long-term enjoyment of these finite natural resources.

- All property owners should contact the Ministry of Natural Resources before undertaking any dredging and/or filling activities within the littoral zone (near-shore shallows) in order to avoid the resuspension of nutrients from the lake's sediments and/or direct physical damage to spawning areas.

It is an offense, subject to prosecution under the *Fisheries Act,* to destroy fish habitat. Wherever

harmful alteration or loss of fish habitat occurs, compensation must be approved by the Department of Fisheries and Oceans.

The Ministry of Natural Resources can provide advice on specific proposals. Where the effects can be adequately mitigated, limited dredging and/or filling projects may be authorized under the *Lakes and Rivers Improvement Act* and the *Public Lands Act*. Any work on shorelands must be authorized by a work permit.

- All property owners are encouraged to contact the Ministry of Natural Resources and the Ministry of the Environment before commencing construction of any new building or structure in order to determine if there may be any adverse impact on the lake trout fishery.

- No new lots for private or commercial purposes shall be created on public (Crown) land with frontage on lakes managed for lake trout.

This direct action by the Ministry of Natural Resources to protect the lake trout resource can be taken wherever publicly owned shoreland remains. Crown ownership is substantial, particularly around many of the lakes.

- Local Councils should include policies (see Appendix A) in their Official Plans or in Interim Land Severance Policies, in the absence of an official plan, which:

  - recognize the value of the lake trout fishery resource;

  - identify lake trout lakes as critical fish habitat;

  - establish land use designations compatible to lake trout fishery management;

  - ensure that implementing bylaws prohibit development incompatible with this resource;

  - provide a review mechanism which requires Council to have regard for the impact of any development on or adjacent to lake trout lakes;

  - provide for consultation with the Ministry of the Environment and the Ministry of Natural Resources for any development on or adjacent to lake trout lakes;

  - permit only one dwelling unit on any private lot with lakeshore frontage on all lake trout waters; and,

  - establish a building setback of generally at least 30 metres horizontally from the water's edge. The policy should further indicate that where Council, in consultation with the ministries of Environment and Natural Resources, determine a lesser setback is acceptable, then the setback may be reduced by rezoning or minor variance without the need for first obtaining an official plan amendment. Boathouses without living accommodations and docks for private use are understood to be permitted within the setback.

Regulating land uses adjacent to lakes will minimize soil erosion and reduce the rate of nutrient input. These are two of the primary causes of lake trout lake degradation.

Where multiple lot developments are proposed, backshore lot designs generally offer the best means to minimize impacts upon the lake environment.

A setback for buildings will discourage other physical improvements such as tile beds, lawns and gardens near the shoreline, thereby widening the buffer of natural vegetation and soil along the lake edge. The setback also complements fisheries management by minimizing impacts of shoreline activities on the important near-shore habitat (littoral zone).

Municipalities, through these actions, will emphasize the importance of critical fish habitat for lake trout communities in providing quality angling experiences and for serving as biological indicators of a healthy environment.

THE FOLLOWING ACTIONS ARE RECOMMENDED FOR THE 32 LAKE TROUT LAKES IN THE HIGHLY SENSITIVE CLASS.

- Policies in municipal official plans (see Appendix A) should generally discourage the creation of *new* single lots with lakeshore frontage, and multiple backlot development for residential purposes, by either severance or plan of subdivision.

- Where the applicant can demonstrate to the satisfaction of Council, in consultation with the ministries of Environment and Natural Resources, that the proposed development will not impact upon the lake, then the creation of new lots for residential purposes may be permitted provided all other policies applicable to the area permit the development. A zoning bylaw amendment shall be required. All other types of uses such as commercial and industrial shall require an amendment to the official plan.

- Permits issued under the *Environmental Protection Act* for private waste disposal systems shall be conditional upon:

  - the system being located at least 30 metres from the shoreline of the lake; and

  - the use of one metre of material below the tile bed consisting of A and B horizons of soil material.

- Where the size, shape or topography of an existing registered lot with lakeshore frontage cannot allow for a 30-metre setback from the shoreline for the private waste disposal system, the distance should be as remote from the shoreline as the lot will permit but not less than 15 metres and the system should be specifically designed for the site.

The most significant place for phosphorus retention is in the top layers of soil under the tile in septic tank tile bed systems. Raised tile beds are commonly required due to the limited depth of soil on many lakeshore properties.

Suitable material is available at most major deposit sites. Generally it is the top one metre of material overlying the main pit deposits which is characteristically light brown or red in colour. The deeper pit-run material has a poor phosphorus retention capability and is *not* suitable for tile bed construction on lake trout lakes.

In summary, the continued existence and long-term management of lake trout lakes can best be served if all dwellings and private waste disposal systems are set back as far as possible from shorelines and if disturbance to the natural vegetation is minimized thereby controlling phosphorus input. These measures also will minimize the potential for production of troublesome localized aquatic weed growth and help to maintain the aesthetic appeal of the lake environment.

Appendix A

SAMPLE POLICIES CONCERNING THE LAKE TROUT FISHERY FOR INCLUSION IN OFFICIAL PLANS OR INTERIM LAND SEVERANCE POLICIES

1. Council recognizes the importance and value of the lake trout resource within the municipality. A high quality fishery provides benefits to the community such as:

   a) recreational benefits;

   b) economic benefits in terms of income generated through angling and tourism;

   c) environmental and aesthetic benefits; and,

   d) social benefits such as clear water and healthy fish populations.

   Accordingly, Council shall encourage development in the municipality to take place in a manner that does not adversely affect habitat essential to the maintenance of a healthy lake trout population. Regulating land use adjacent to lakes will minimize soil erosion and reduce the rate of nutrient input. These are two primary causes of lake trout habitat degradation.

   The following policies implement the municipal actions suggested in the MNR/MOE joint report *Inland Lake Trout Management in Southeastern Ontario.*

2. Lakes containing habitat considered essential to the maintenance of healthy lake trout populations in the municipality are specifically shown on Schedule "-".

   OR [where a textual reference is used]

   The following list identifies waterbodies considered by the municipality to be critical habitat for the maintenance of healthy lake trout populations.

3. On lands adjacent to identified lake trout lakes only one dwelling unit may be permitted on any lot with lakeshore frontage.

4. In considering an amendment to the official plan and/or the zoning bylaw and any consent or subdivision application on or adjacent to these lakes to permit any use besides residential or open space, Council shall, in consultation with the Ministry of Natural Resources and the Ministry of the Environment, have regard to the following matters:

   a) the effect the proposal will have on the lake trout habitat including water quality requirements;

   b) methods by which any negative impacts on the lake trout habitat can be minimized; and,

   c) the need to provide or maintain public access.

   Backshore lot designs generally offer the best means to address these matters.

5. Prior to making a final decision on development applications and/or amendments referred to in 4 above, Council may require additional studies to ensure that the resulting development does not adversely affect lake trout habitat.

6. Council shall encourage and support the Ministry of Natural Resources and the Ministry of the Environment in their efforts to maintain, or where required, improve the quality of lake trout habitat within the municipality in accordance with relevant fish management legislation such as the *Game and Fish Act,* and the federal *Fisheries Act.*

7. Prior to constructing, funding, or supporting public projects, such as municipal road or drainage works on land within or adjacent to identified lake trout lakes, Council shall consult with the Ministry of Natural Resources and the Ministry of the Environment to determine

what design requirements, if any, are necessary to eliminate or mitigate adverse effects on the lake trout habitat, including water quality requirements.

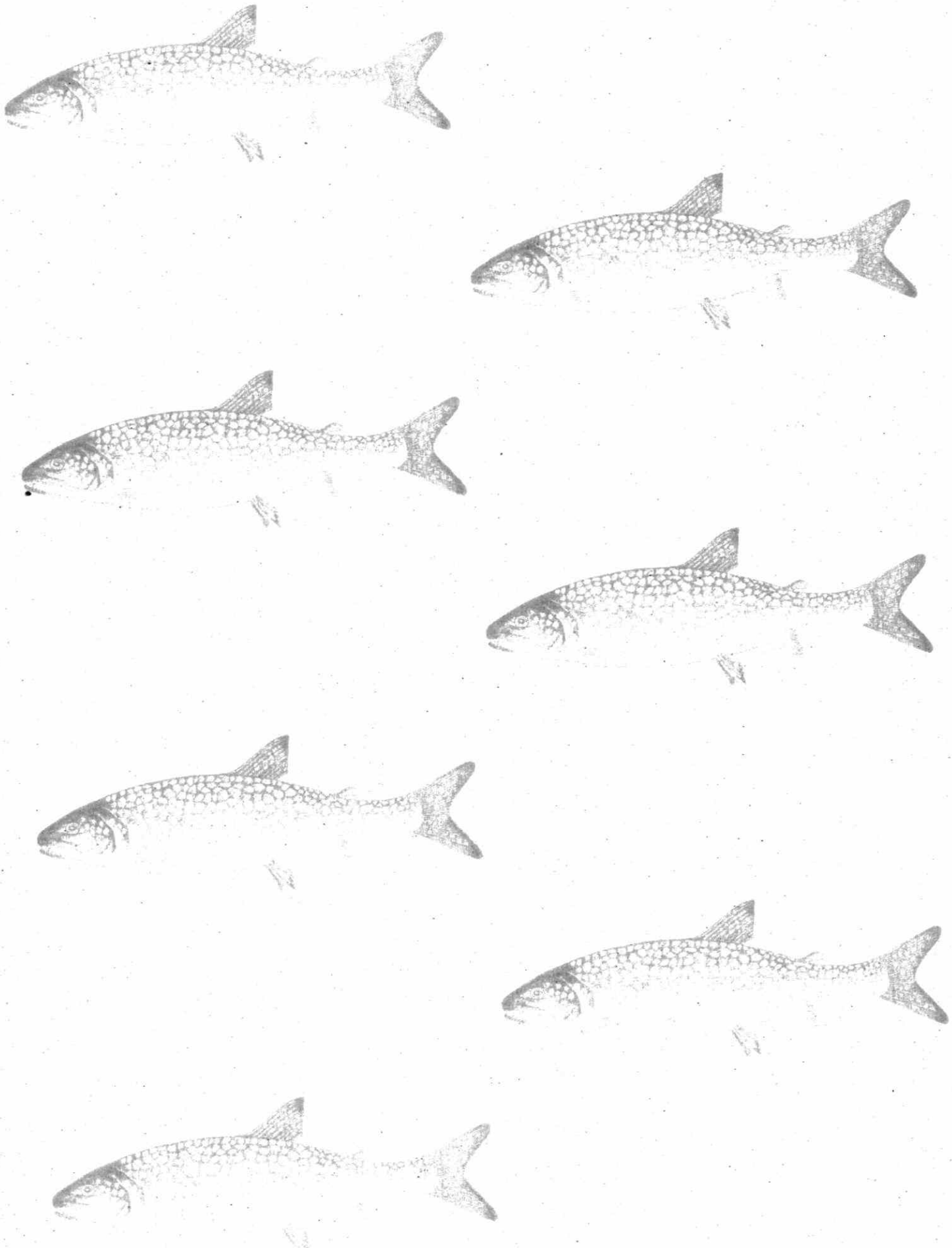
8. In the implementing zoning bylaw, land uses that would result in the destruction or degradation of fish habitat or otherwise inhibit fisheries management, shall be prohibited from being located in or adjacent to identified lake trout lakes.

9. The development setback for all lots on identified lake trout lakes shall be generally at least 30 metres measured horizontally from the water's edge. This figure may be decreased in consultation with the Ministry of the Environment and the Ministry of Natural Resources, without an official plan amendment. A zoning bylaw amendment or minor variance shall be required. Notwithstanding this setback, boathouses without living accommodations and docks for private use may be permitted.

10. On lands adjacent to lake trout lakes in the Highly Sensitive class, the creation of new lots for residential purposes by either consent or plan of subdivision shall be generally discouraged. As a result, the zoning bylaw shall prohibit buildings on lands adjacent to Highly Sensitive class lakes.

    Where the applicant can demonstrate no impact upon the lake to the satisfaction of Council, in consultation with the Ministry of the Environment and the Ministry of Natural Resources, lots may be created without an official plan amendment but a zoning bylaw amendment shall be required.

    All other types of uses such as commercial and industrial shall require an amendment to the official plan.



Appendix B

DATA SUMMARY
INLAND LAKES MANAGEABLE FOR LAKE TROUT

Ashby Lake

LOCATION

County ..... Lennox & Addington
Township ..... Ashby
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

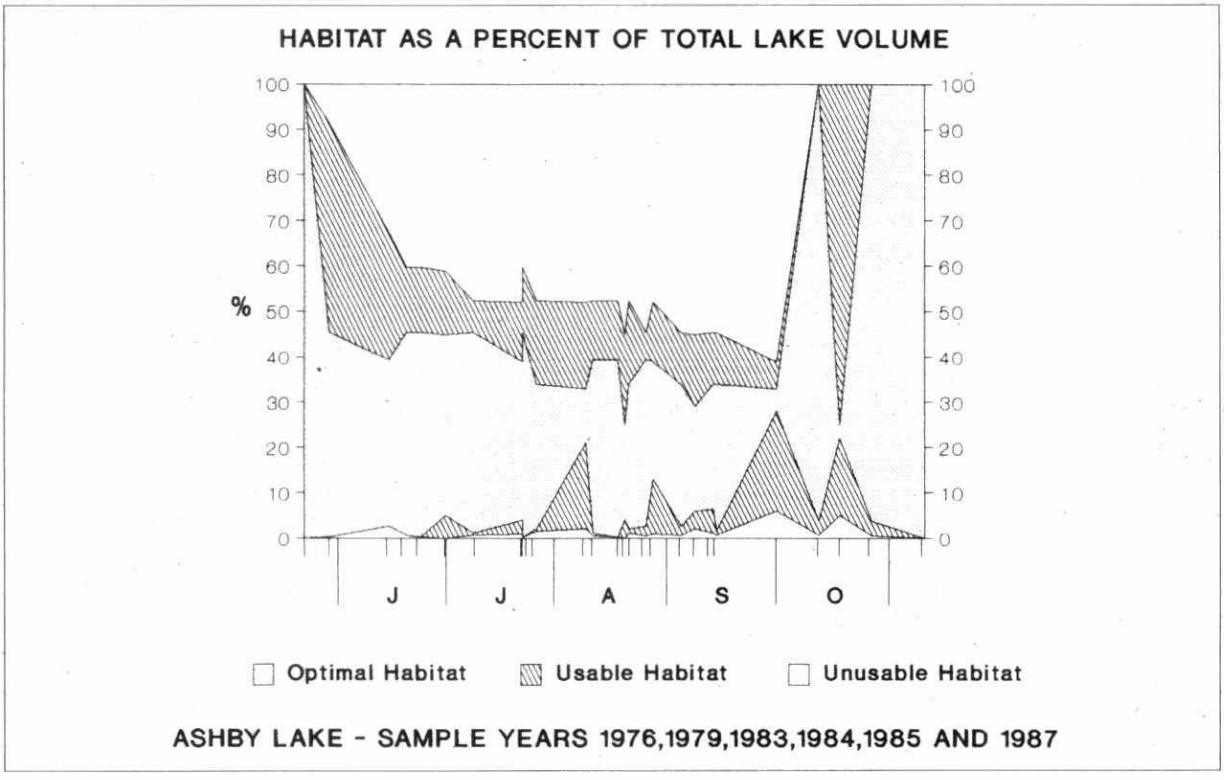
Surface Area ..... 2.660 x $10^6 m^2$
Epilimnion Volume ..... 23.230 x $10^6 m^3$
Hypolimnion Volume ..... 7.610 x $10^6 m^3$
Total Volume ..... 30.840 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 3.053
Maximum Depth ..... 36.6 m
Mean Depth ..... 11.6 m

HYDROLOGY

Watershed Area ..... 36.78 x $10^6 m^2$
Flushing Rate ..... 0.42 times/year
Outflow Volume ..... 12.98 x $10^6 m^3$
Areal Water Load ..... 5.0 m
Retention Coefficient 0.71

WATER QUALITY

Mean Summer Secchi Disc ..... 6.4 m
Chlorophyll a ..... 1.2 µg/L
Total Phosphorus ..... 5.0 µg/L
Total Nitrogen ..... 293 µg/L
TDS ..... 33.15 mg/L
Depth of Water Column — Optimal ..... 10 m
— Usable ..... 23 m
Optimal Habitat as a Percentage of Total Lake Volume 19
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 44
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index 57
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Ashby Lake reveal good water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season. The lake trout habitat model predicts that Ashby Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin.....Native(supplemented by plantings from 1973-82)
Lake Trout Potential Annual Yield .....141 kg or 0.53 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....No excessive stress factors identified

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1979 (March 10-31)	1,195.0	4.5	n/a	
1981 (March 14-29)	112.0	0.4	n/a	
1989 (March 11-31)	187.0	0.7	15	0.02
1990 (March 10-31)	136.3	0.5	11	0.02
1991 (March 9-31)	730.6	2.7	n/a	
(May 19-Sept.8)	3,110.9	11.7	n/a	
1992 (March 14-31)	1,646.0	6.2	n/a	

FISHERIES SUMMARY

Natural water level regime.

Ashby Lake is presently believed to support a healthy lake trout population.

Future management efforts should be directed to maintaining or enhancing the resident lake trout population. Lake trout stocking will continue but will be reduced or phased out over the long term. In order to provide alternate angling opportunities and divert fishing pressure away from Ashby Lake the salmonid stocking program of other species such as splake, rainbow trout and brook trout will be increased in the immediate area.

Efforts must also be directed toward protecting existing habitat and rehabilitating degraded habitat.
Programs should be maintained to document fishing pressure and harvest.

SHORELINE DEVELOPMENT

Residences
- permanent .....–
- seasonal 85
- total 85

Private Vacant Lots.....1
Tourist Establishment
- number 1
- rooms/cabins 3
- campsites.....–

Provincial Park Campsites .....–
% Shoreline Crown 66
% Shoreline Patent 34

Cottages are strung along the south and east shores. Much of the development includes docks, boathouses, garages, hydro and plumbing.

Ashden (Ashby White) Lake

LOCATION

County.....Lennox & Addington
Township.....Ashby
Watershed .....Madawaska River
Angling Division.....29

MORPHOMETRY

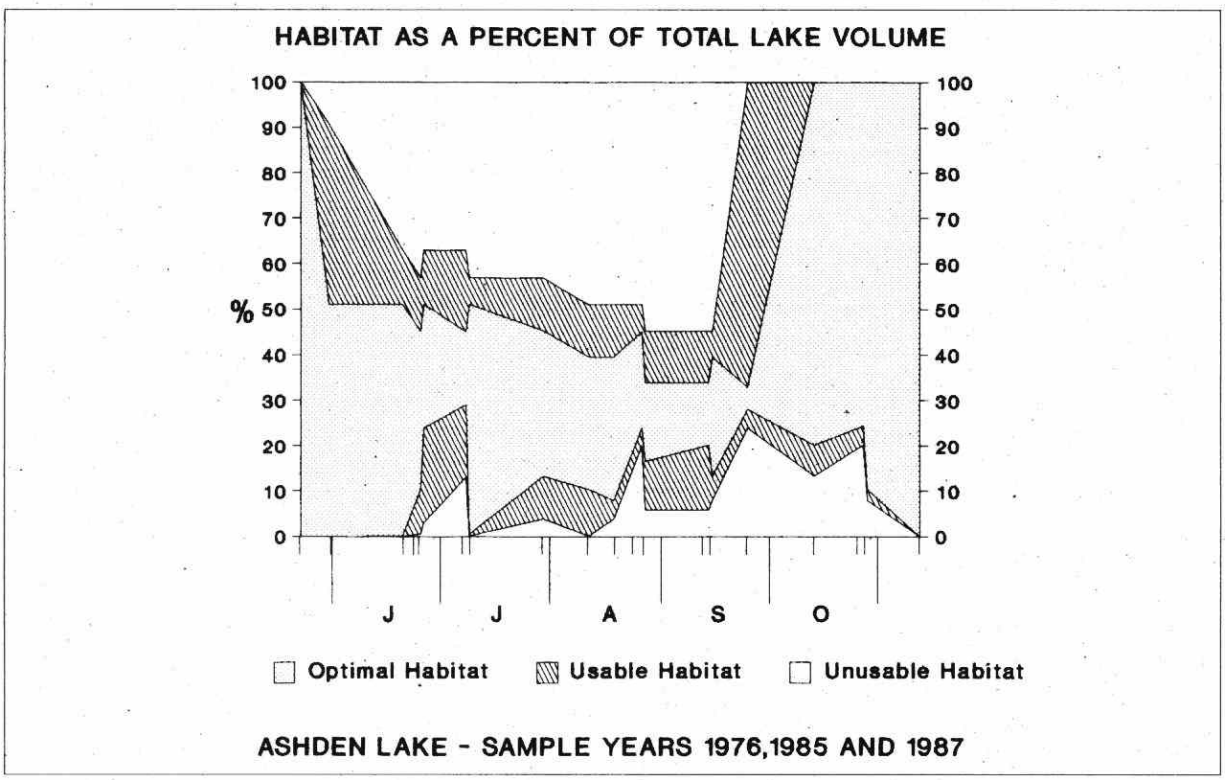
Surface Area.....1.380 x $10^6 m^2$
Epilimnion Volume .....10.440 x $10^6 m^3$
Hypolimnion Volume .....3.250 x $10^6 m^3$
Total Volume .....13.690 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 3.212
Maximum Depth .....25.0 m
Mean Depth .....9.9 m

HYDROLOGY

Watershed Area.....12.17 x $10^6 m^2$
Flushing Rate.....0.29 times/year
Outflow Volume .....4.01 x $10^6 m^3$
Areal Water Load.....2.91 m
Retention Coefficient 0.81

WATER QUALITY

Mean Summer Secchi Disc.....6.7 m
Chlorophyll a .....1.8 µg/L
Total Phosphorus .....12.0 µg/L
Total Nitrogen .....390 µg/L
TDS .....120.25 mg/L
Depth of Water Column — Optimal .....3 m
— Usable .....7 m
Optimal Habitat as a Percentage of
Total Lake Volume.....16
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume.....35
Aug. 31(≤15.5°C & ≥4 ppm 0_2)
Sensitivity Index.....100+
Classification.....Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Ashden Lake reveal good water quality conditions for lake trout. Average chlorophyll levels are low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season. The lake trout habitat model predicts that Ashden Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, rainbow trout
Lake Trout Origin.....Native (supplemented by small historic plantings)
Lake Trout Potential Annual Yield .....150 kg or 1.09 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....No excessive stress factors identified

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	374.6	2.7	n/a	
1990 (March 10-31)	577.3	4.2	21	0.59
1991 (March 9-31)	426.0	3.1	n/a	
(May 19-Sept.8)	1,058.7	7.7	n/a	
1992 (March 14-31)	412.4	3.0	n/a	

FISHERIES SUMMARY

Natural water level regime.

The lake trout population of Ashden Lake is believed to be in good condition. Future management activities should maintain or enhance the resident population. Lake trout stocking will continue but will be reduced or phased out over the long term. In order to provide alternate angling opportunities and divert fishing pressure away from Ashden Lake the salmonid stocking program of other species such as splake, rainbow trout and brook trout will be expanded in the Ashden Lake vicinity. Habitat protection must also be a prime consideration in future activities. Future efforts should be directed to maintaining baseline data on fishing pressure and harvest for Ashden Lake.

SHORELINE DEVELOPMENT

Residences
- permanent..... –
- seasonal 10
- total.....10

Private Vacant Lots 1
Tourist Establishments
- number..... –
- rooms/cabins..... –
- campsites..... –

Provincial Park Campsites..... –
% Shoreline Crown 60
% Shoreline Patent.....40

Ashden Lake is sparsely developed.

Barker Lake

LOCATION

County ..... Lennox & Addington
Township ..... Ashby
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

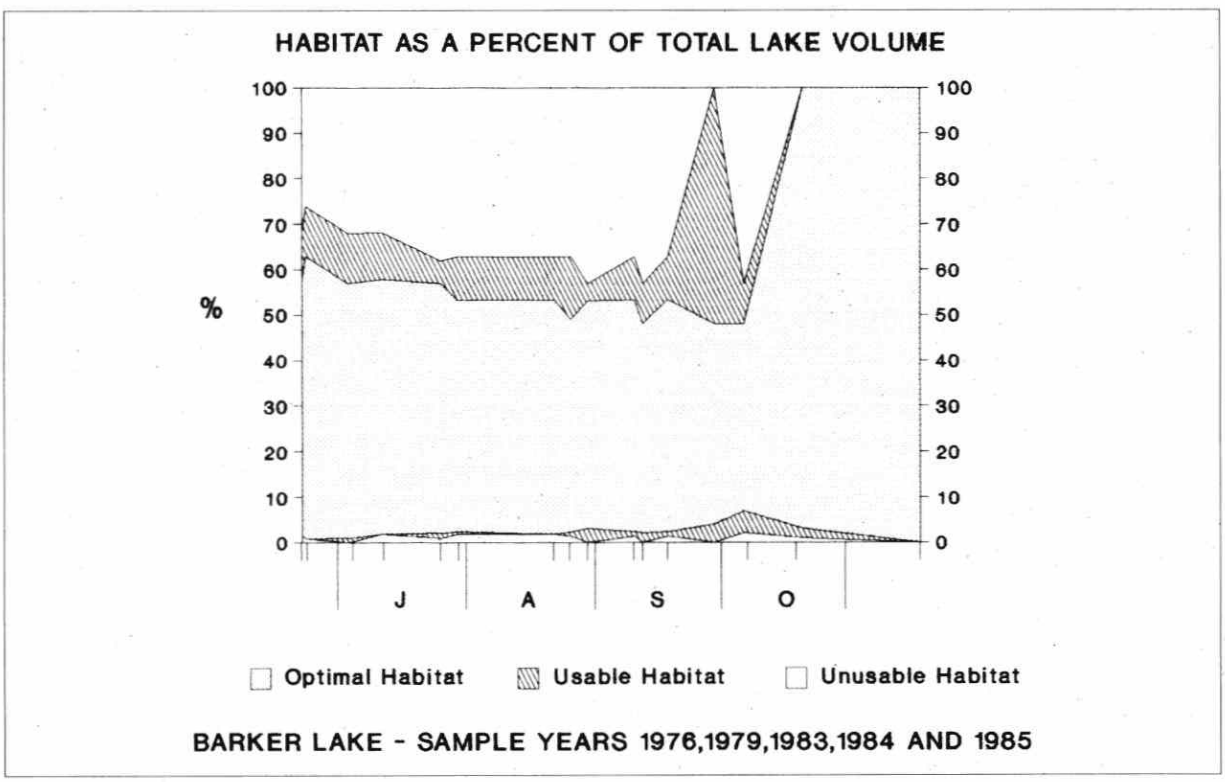
Surface Area ..... $1.730 \times 10^6 m^2$
Epilimnion Volume ..... $11.400 \times 10^6 m^3$
Hypolimnion Volume ..... $10.710 \times 10^6 m^3$
Total Volume ..... $22.111 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.064
Maximum Depth ..... 38.1 m
Mean Depth ..... 12.8 m

HYDROLOGY

Watershed Area ..... $21.24 \times 10^6 m^2$
Flushing Rate ..... 0.32 times/year
Outflow Volume ..... $7.09 \times 10^6 m^3$
Areal Water Load ..... 4.18 m
Retention Coefficient 0.75

WATER QUALITY

Mean Summer Secchi Disc ..... 5.8 m
Chlorophyll a ..... 1.4 µg/L
Total Phosphorus ..... 7.0 µg/L
Total Nitrogen ..... 302 µg/L
TDS ..... 33.80 mg/L
Depth of Water Column — Optimal ..... 20 m
— Usable ..... 30 m
Optimal Habitat as a Percentage of Total Lake Volume 45
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 57
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index 32
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

Surveys of Barker Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season. According to the lake trout habitat model predictions, Barker Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species .....Lake trout
Lake Trout Origin.....Native
(has been supplemented with some plantings)
Lake Trout Potential Annual Yield.....88 kg or 0.51 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors .....Susceptible to acidic loading

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1979 (March 11-31)	1,142.0	6.6	n/a	
1989 (March 11-31)	462.5	2.7	65	0.20
1990 (March 10-31)	840.2	4.9	62	0.15
1991 (March 9-31)	1,068.5	6.2	127	0.35
(May 19-Sept.8)	1,802.1	10.4	n/a	
1992 (March 14-31)	861.0	5.0	n/a	

FISHERIES SUMMARY

Natural water level regime.

The resident lake trout population in Barker Lake is believed to be in relatively good condition. Future management efforts should be directed to maintaining or enhancing the resident population. Lake trout stocking will continue but shall be reduced or phased out over the long term. In order to provide alternate angling opportunities and divert fishing pressure away from Barker Lake, the salmonid stocking program of species such as splake, brook trout and rainbow trout will be expanded in the local area.

Efforts should also focus on habitat protection including mitigative techniques to reduce the potential adverse effects of acidic precipitation. Future studies should be maintained to establish baseline information on fishing pressure and harvest.

SHORELINE DEVELOPMENT

Residences
- permanent.....–
- seasonal 2
- total 2

Private Vacant Lots .....–
Tourist Establishments
- number..... –
- rooms/cabins ..... –
- campsites..... –

Provincial Park Campsites..... –
% Shoreline Crown 99
% Shoreline Patent.....1

Development is expected to remain minimal.

Barnard Lake

LOCATION

County.....Lennox & Addington
Township.....Ashby
Watershed.....Madawaska River
Angling Division.....29

MORPHOMETRY

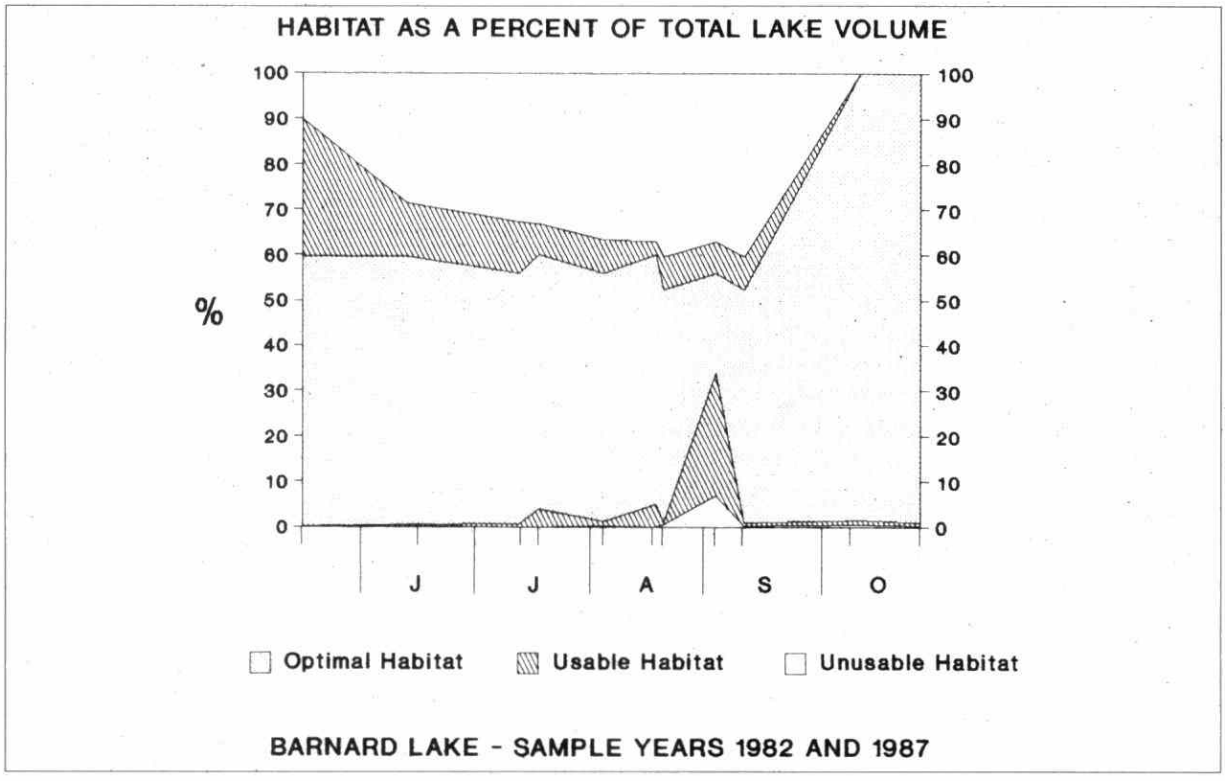
Surface Area.....0.390 x $10^6 m^2$
Epilimnion Volume.....3.750 x $10^6 m^3$
Hypolimnion Volume.....3.600 x $10^6 m^3$
Total Volume.....7.350 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion.....1.042
Maximum Depth.....48.2 m
Mean Depth.....18.8 m

HYDROLOGY

Watershed Area.....1.15 x $10^6 m^2$
Flushing Rate.....0.04 times/year
Outflow Volume.....0.33 x $10^6 m^3$
Areal Water Load.....0.86 m
Retention Coefficient.....0.94

WATER QUALITY

Mean Summer Secchi Disc.....6.4 m
Chlorophyll a.....1.7 µg/L
Total Phosphorus.....6.7 µg/L
Total Nitrogen.....75 µg/L
TDS.....23.40 mg/L
Depth of Water Column — Optimal.....7 m
— Usable.....23 m
Optimal Habitat as a Percentage of
Total Lake Volume.....22
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume.....56
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index.....100+
Classification.....Highly Sensitive



WATER QUALITY SUMMARY

Surveys in 1982 and 1987 of Barnard Lake reveal good water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season.

The lake trout habitat model predicts that Barnard Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout
Lake Trout Origin .....Native (lake trout have never been planted)
Lake Trout Potential Annual Yield .....13 kg or 0.34 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Susceptible to acidic loading

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	34.1	0.9	n/a	
1990 (March 10-31)	0.0	0.0	n/a	
1991 (March 9-31)	411.0	10.5	n/a	
(May 19-Sept.8)	0.0	0.0	n/a	
1992 (March 14-31)	292.8	7.5	n/a	

FISHERIES SUMMARY

Natural water level regime.

Despite a lack of data, the resident lake trout population is considered to be in relatively good condition. Future management efforts should be directed to maintaining or enhancing the resident lake trout population without stocking. In order to provide alternate angling opportunities and divert fishing pressure away from Barnard Lake, the salmonid stocking program for other species such as splake, rainbow trout and brook trout will be expanded in the local area.

Efforts should also focus on habitat protection including mitigative techniques to reduce the potential adverse effects of acidic precipitation. Programs should be maintained to establish baseline information on fishing pressure and harvest.

SHORELINE DEVELOPMENT

Barnard Lake is situated in a block of Crown land; there are two hunt camps on the south shore.

Big Clear Lake

LOCATION

County ..... Frontenac
Township ..... Bedford
Watershed ..... Cataraqui River
Angling Division 9

MORPHOMETRY

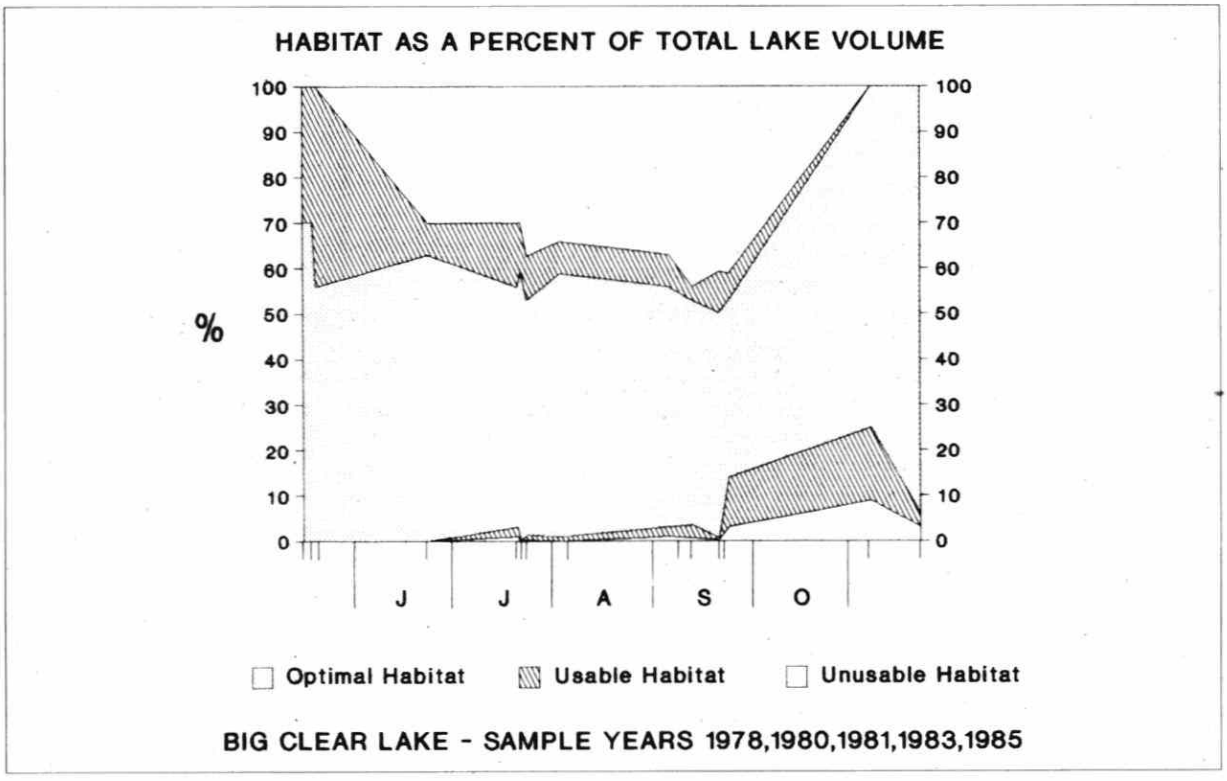
Surface Area ..... 1.690 x $10^6 m^2$
Epilimnion Volume ..... 16.099 x $10^6 m^3$
Hypolimnion Volume ..... 18.171 x $10^6 m^3$
Total Volume ..... 34.270 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 0.886
Maximum Depth ..... 61.0 m
Mean Depth ..... 20.3 m

HYDROLOGY

Watershed Area ..... 8.75 x $10^6 m^2$
Flushing Rate ..... 0.08 times/year
Outflow Volume ..... 2.76 x $10^6 m^3$
Areal Water Load 1.63m
Retention Coefficient 0.88

WATER QUALITY

Mean Summer Secchi Disc ..... 8.4 m
Chlorophyll a ..... 1.3 µg/L
Total Phosphorus ..... 7.0 µg/L
Total Nitrogen ..... 227 µg/L
TDS ..... 48.75 mg/L
Depth of Water Column — Optimal ..... 26 m
— Usable ..... 42 m
Optimal Habitat as a Percentage of Total Lake Volume 44
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 58
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index 34
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

Surveys of Big Clear Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Big Clear Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin.....Native (supplemented by annual plantings)
Lake Trout Potential Annual Yield.....83 kg or 0.49 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Excessive angler harvest

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1981 (June 6-Sept. 8)	993.0	5.3	58	0.43
1983 (June 4-Sept. 8)	506.0	2.7	8	0.06
1985 (June 1-Sept. 8)	450.0	2.4	69	n/a
1987 (June 6-Sept. 8)	439.0	2.3	45	0.52
1991 (June 1-Sept. 8)	3,653.5	19.4	n/a	

FISHERIES SUMMARY

Natural water level regime.

Lake being monitored (long-term) by Rideau Lakes Fisheries Assessment Unit.

Traditionally had heavy winter angling pressure; currently there is no open winter season. Big Clear Lake supports a popular lake trout fishery. Future management efforts should include reducing the harvest by such means as shorter seasons, reduced possession limits and/or bait restrictions. In order to direct fishing pressure away from the native population in Big Clear Lake the salmonid stocking program for other species such as splake, rainbow trout and brook trout, will be increased in the immediate area. Efforts should also be made to protect and enhance existing fisheries habitat.

SHORELINE DEVELOPMENT

Residences
- permanent.....–
- seasonal.....14
- total.....14

Private Vacant Lots.....8
Tourist Establishments
- number.....–
- rooms/cabins.....–
- campsites.....–

Provincial Park Campsites (interior use only).....1 cluster; total 3
% Shoreline Crown.....35
% Shoreline Patent.....65

Big Ohlmann Lake

LOCATION

County ..... Frontenac
Township ..... Miller
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

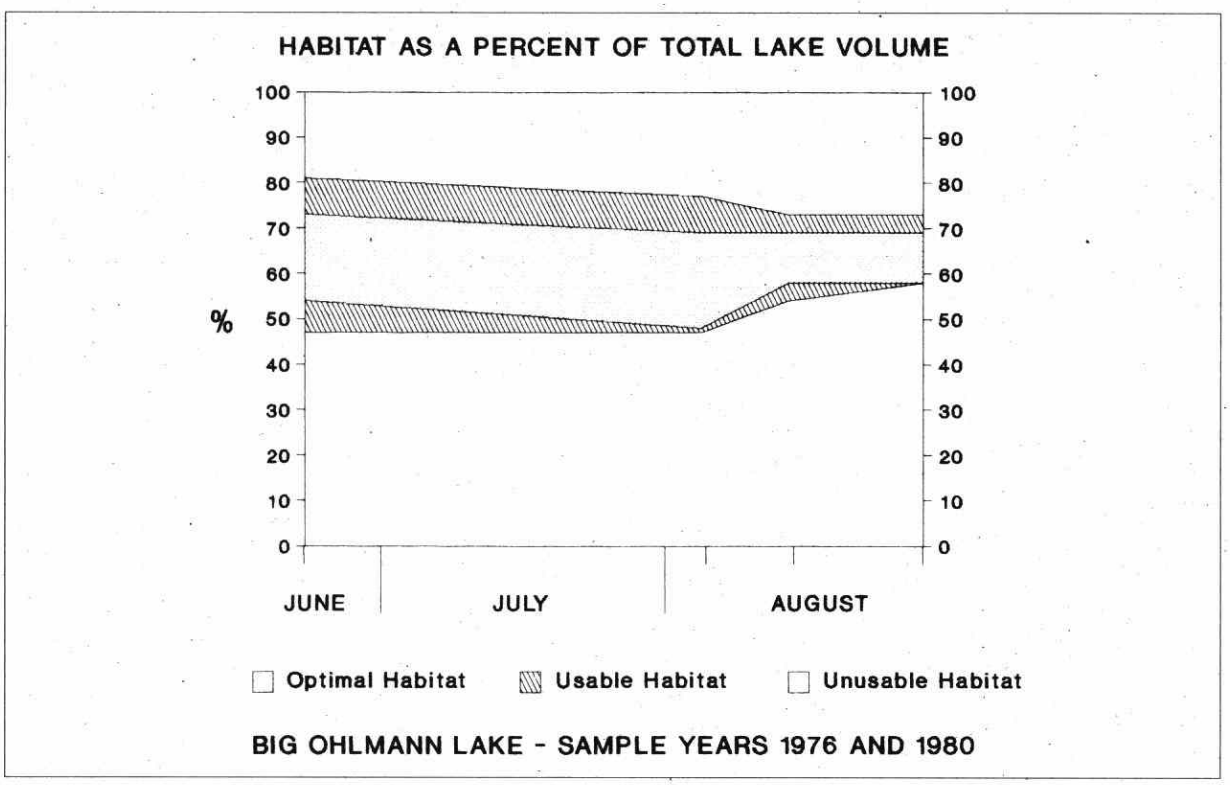
Surface Area ..... 0.320 x $10^6 m^2$
Epilimnion Volume ..... 2.790 x $10^6 m^3$
Hypolimnion Volume ..... 3.780 x $10^6 m^3$
Total Volume ..... 6.570 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 0.738
Maximum Depth ..... 42.1 m
Mean Depth ..... 20.5 m

HYDROLOGY

Watershed Area ..... 1.89 x $10^6 m^2$
Flushing Rate ..... 0.09 times/year
Outflow Volume ..... 0.59 x $10^6 m^3$
Areal Water Load ..... 1.84 m
Retention Coefficient 0.87

WATER QUALITY

Mean Summer Secchi Disc ..... 6.2 m
Chlorophyll a ..... 2.3 µg/L
Total Phosphorus ..... 26 µg/L
Total Nitrogen ..... 439 µg/L
TDS ..... 66.30 mg/L
Depth of Water Column — Optimal ..... 2 m
— Usable ..... 24 m
Optimal Habitat as a Percentage of Total Lake Volume 8
Aug. 31 (≤ 10°C & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 15
Aug. 31 (≤ 15.5°C & ≥ 4 ppm O_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1976 and 1980 surveys of Big Ohlmann Lake revealed only marginal water quality conditions for lake trout. Although average chlorophyll levels are low, temperature and oxygen profiles show limited optimal habitat exists late in the stratified season.

Big Ohlmann Lake is a meromictic lake and therefore, not suitable for predictions using the lake trout habitat model. From an empirical evaluation it is concluded that Big Ohlmann Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin .....Introduced
Lake Trout Potential Annual Yield
.....18 kg or 0.56 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors.....Degradation/loss of spawning beds

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1979 (March 10-31	2,248	70.3	n/a	
1981 (March 14-29)	94.6	3.0	n/a	
1989 (March 11-31)	202.8	6.3	12	0.42
1990 (March 10-31)	163.6	5.1	n/a	
1991 (March 9-31)	375.9	11.8	n/a	
(May 19- Sept.8)	801.4	25.0	n/a	
1992 (March 14-31)	114.2	3.6	n/a	

FISHERIES SUMMARY

Natural water level regime.

Future management activities should include the protection and rehabilitation of spawning sites and other critical fisheries habitat. In order to protect the native lake trout population from overharvest it may be necessary to shorten the angling season, reduce daily catch and possession limits and implement bait restrictions.

Supplemental lake trout plantings will continue but will be reduced or phased out over the long term. In order to direct fishing pressure away from native lake trout stocks, numerous other lakes in the area will be planted with other salmonids such as splake, brook trout and rainbow trout.

Efforts should also be directed to establishing or maintaining some program to estimate fishing pressure and harvest.

SHORELINE DEVELOPMENT

Residences
- permanent 1
- seasonal 3
- total.....4

Private Vacant Lots .....n/a
Tourist Establishments
- number.....–
- rooms/cabins .....–
- campsites.....–

Provincial Park Campsites .....–
% Shoreline Crown.....60
% Shoreline Patent 40

There is one public access point; the lake is very sparsely developed.

Big Rideau Lake

LOCATION

County.....Leeds
Township .....North & South Burgess, Bastard, North & South Elmsley, North Crosby
Watershed .....Rideau River
Angling Division 10

MORPHOMETRY

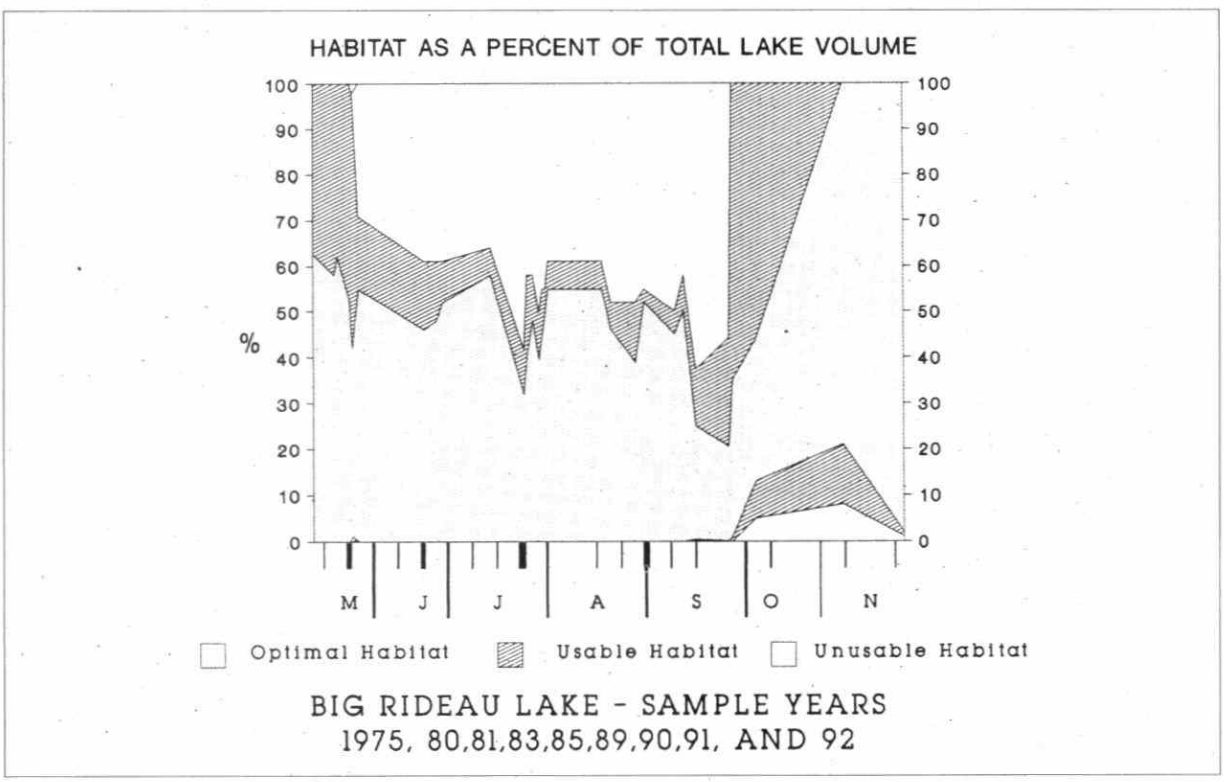
Surface Area .....46.480 x $10^6 m^2$
Epilimnion Volume.....356.377 x $10^6 m^3$
Hypolimnion Volume.....357.072 x $10^6 m^3$
Total Volume.....713.449 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 0.998
Maximum Depth.....100.3 m
Mean Depth .....15.3 m

HYDROLOGY

Watershed Area .....431.2 x $10^6 m^2$
Flushing Rate .....0.20 times/year
Outflow Volume.....144.86 x $10^6 m^3$
Areal Water Load.....3.12 m
Retention Coefficient.....0.80

WATER QUALITY

Mean Summer Secchi Disc .....4.0 m
Chlorophyll a.....2.4 µg/L
Total Phosphorus .....19.2 µg/L
Total Nitrogen .....345 µg/L
TDS .....136.50 mg/L
Depth of Water Column - Optimal.....72 m
- Usable .....81 m
Optimal Habitat as a Percentage of Total Lake Volume.....39
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume.....52
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index.....3
Classification .....Moderately Sensitive



BIG RIDEAU LAKE - SAMPLE YEARS
1975, 80,81,83,85,89,90,91, AND 92

WATER QUALITY SUMMARY

Surveys of Big Rideau Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Big Rideau Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, walleye, largemouth bass, smallmouth bass, northern pike
Lake Trout Origin.....Native (supplemented by regular plantings)
Lake Trout Potential Annual Yield .....6838 kg or 1.04 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Excessive angler harvest, adverse water level fluctuations and introductions of undesirable fish species

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Date s)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1981 (June 6-Sept. 8)	72,578.0	15.6	6,701	1.44
1983 (June 4-Sept. 8)	77,706.0	16.7	7,269	1.56
1985 (June 1-Sept. 8)	91,820.0	19.8	6,084	1.31
1987 (June 6-Sept. 8)	70,301.0	15.1	7,364	1.58
1989 (June 3-Sept. 8)	82,844.0	17.8	4,228	0.91
1990 (May 12-Oct. 7)	73,467.7	15.8	n/a	
1991 (June 1-Sept. 8)	56,102.6	12.1	n/a	

FISHERIES SUMMARY

Water levels controlled by Environment Canada Parks Service (Rideau Canal).

The lake is being monitored (long-term) by the Rideau Lake Fisheries Assessment Unit.

Big Rideau Lake should be managed for the resident, self sustaining lake trout population. Supplemental lake trout plantings will continue but will be reduced or phased out over the long term. An experimental stocking program involving the use of "native" strain fish, will be implemented on a trial basis. In order to provide alternate angling opportunities and divert pressure away from the Big Rideau lake trout population, the salmonid stocking program for other species such as splake, rainbow trout and brook trout will increase in other nearby lakes.

In order to protect the native lake trout population from overharvest, shorter angling seasons, reduced possession limits or bait restrictions may be required.

Negotiations should continue with the Parks Service for the implementation of water level regimes which are favourable to lake trout spawning, egg incubation and early rearing. Efforts should also be directed to protecting and enhancing existing habitat.

SHORELINE DEVELOPMENT

Residences
- permanent.....170
- seasonal.....854
- total.....1024

Private Vacant Lots.....297
Tourist Establishments
- number.....9
- rooms/cabins.....244
- campsites.....348

Provincial Park Campsites.....182
% Shoreline Crown.....5
% Shoreline Patent.....95

Big Salmon Lake

LOCATION

County ..... Frontenac
Township ..... Bedford, Loughborough
Watershed ..... Cataraqui River
Angling Division 9

MORPHOMETRY

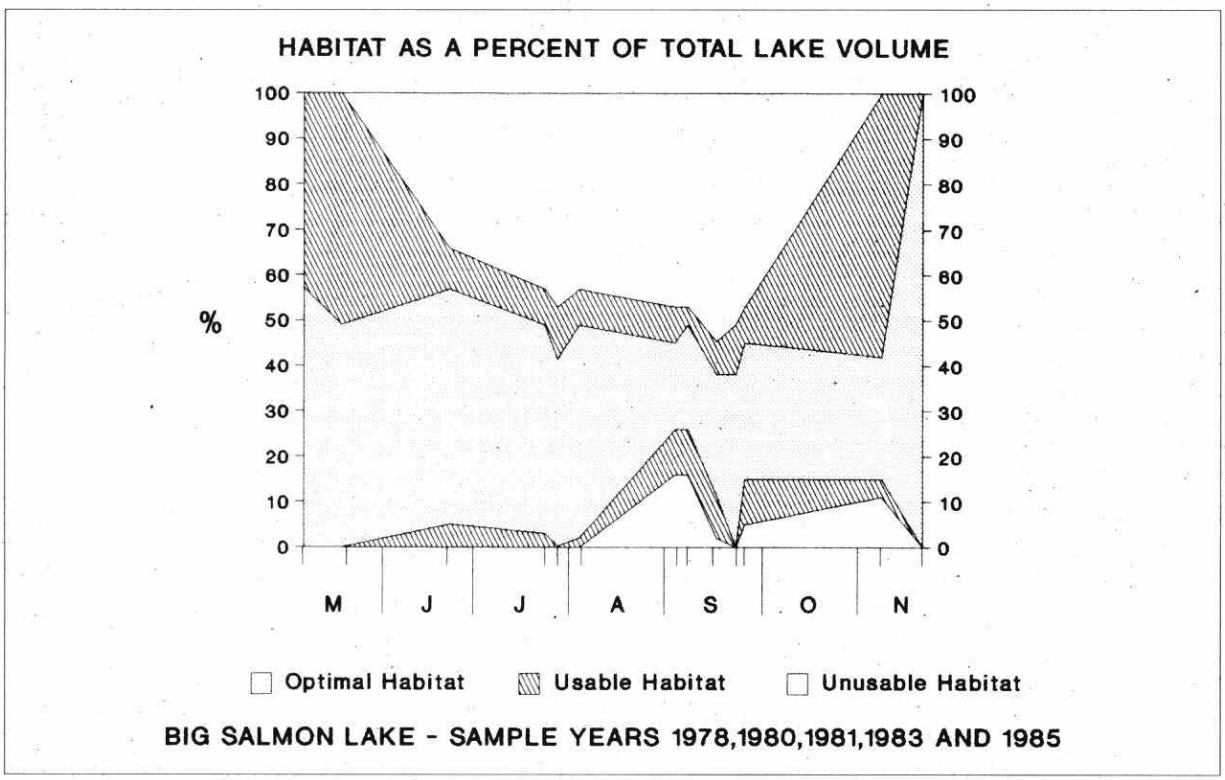
Surface Area ..... 1.710 x $10^6 m^2$
Epilimnion Volume ..... 13.350 x $10^6 m^3$
Hypolimnion Volume ..... 9.550 x $10^6 m^3$
Total Volume ..... 22.900 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.398
Maximum Depth ..... 42.0 m
Mean Depth ..... 13.3 m

HYDROLOGY

Watershed Area ..... 9.85 x $10^6 m^2$
Flushing Rate ..... 0.14 times/year
Outflow Volume ..... 3.22 x $10^6 m^3$
Areal Water Load ..... 1.87 m
Retention Coefficient 0.87

WATER QUALITY

Mean Summer Secchi Disc ..... 8.0 m
Chlorophyll a ..... 1.7 µg/L
Total Phosphorus ..... 9.0 µg/L
Total Nitrogen ..... 283 µg/L
TDS ..... 5785 mg/L
Depth of Water Column - Optimal ..... 13 m
- Usable ..... 21 m
Optimal Habitat as a Percentage of
Total Lake Volume 34
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 50
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index 72
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Big Salmon Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season.

The lake trout habitat model predicts that Big Salmon Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin .....Native (supplemented with some plantings)
Lake Trout Potential Annual Yield .....112 kg or 0.65 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors.....Excessive angler harvest

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1981 (June 6-Sept. 8)	3,923.0	26.5	315	2.13
1983 (June 4-Sept. 8)	1,517.0	10.3	75	0.71
1991 (June 1-Sept. 8)	4,913.1	33.2	n/a	

FISHERIES SUMMARY

Natural water level regime.

Estimated lake trout harvest exceeds annual production.

The lake is being monitored (long term) by Rideau Lakes Fisheries Assessment Unit.

Despite the problem of overharvest, the lake trout population of Big Salmon Lake is still believed to be in good condition.
Future management efforts should be directed toward reducing harvest by means of shorter seasons, reduced catch and possession limits and bait restrictions.

Supplemental lake trout stocking will continue but will be reduced or phased out over the long term. In order to provide alternate fisheries and divert angling pressure away from resident lake trout stocks a number of other lakes in the area will be planted with species such as splake, rainbow trout and brook trout. Future efforts should also be directed to protecting existing lake trout habitat.

SHORELINE DEVELOPMENT

The lake is situated in Frontenac Provincial Park.

There are a total of 10 interior tent sites clustered in three areas on the lakeshore.

Birch Lake

LOCATION

County ..... Frontenac
Township ..... Bedford
Watershed ..... Cataraqui River
Angling Division 9

MORPHOMETRY

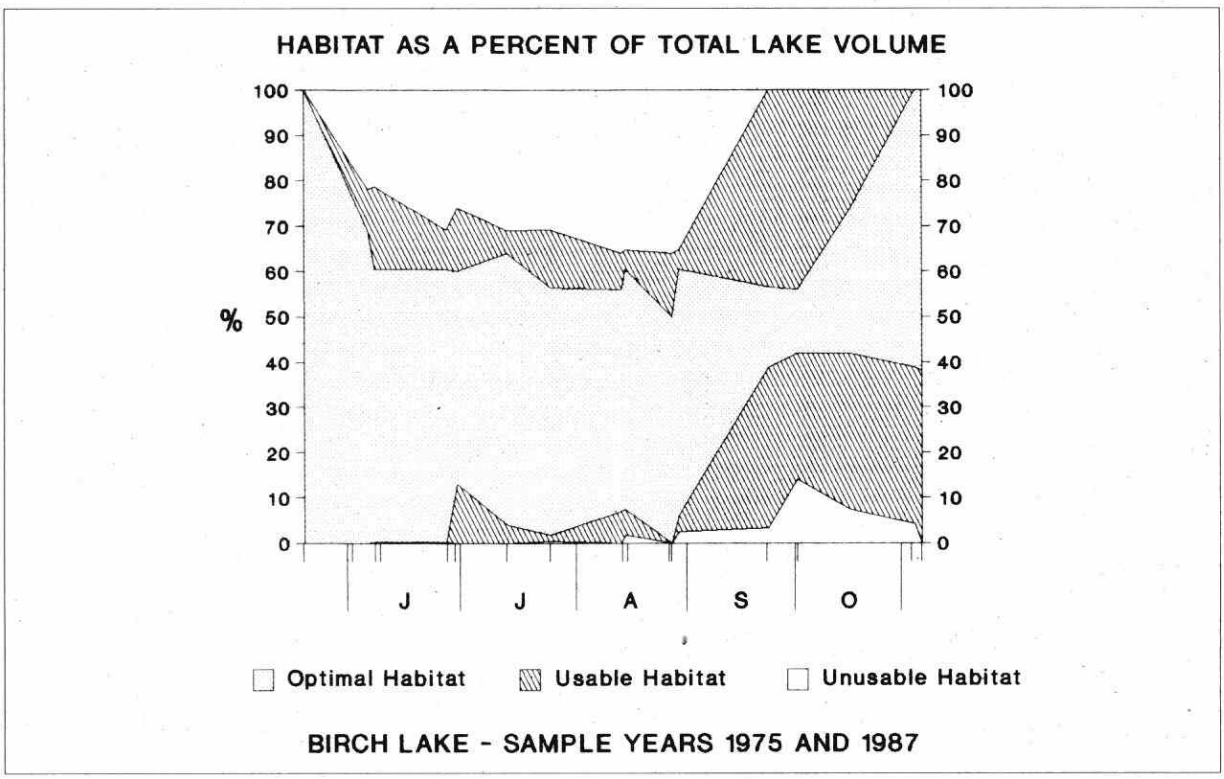
Surface Area ..... 1.950 x $10^6 m^2$
Epilimnion Volume ..... 17.445 x $10^6 m^3$
Hypolimnion Volume ..... 16.555 x $10^6 m^3$
Total Volume ..... 34.000 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 0.949
Maximum Depth ..... 40.0 m
Mean Depth ..... 17.4 m

HYDROLOGY

Watershed Area ..... 125.10 x $10^6 m^2$
Flushing Rate ..... 1.38 times/year
Outflow Volume ..... 46.89 x $10^6 m^3$
Areal Water Load ..... 24.04 m
Retention Coefficient 0.34

WATER QUALITY

Mean Summer Secchi Disc ..... 5.5 m
Chlorophyll a ..... 2.4 µg/L
Total Phosphorus ..... 12.0 µg/L
Total Nitrogen ..... 337 µg/L
TDS ..... 106.6 mg/L
Depth of Water Column - Optimal ..... 7 m
- Usable ..... 24 m
Optimal Habitat as a Percentage of
Total Lake Volume 23
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of
Total Lake Volume 64
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm O_2)
Sensitivity Index 24
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

The 1975 and 1987 surveys of Birch Lake reveal good water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate optimal habitat is present throughout the stratified season.

According to the lake trout habitat model predictions, Birch Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass, northern pike
Lake Trout Origin.....Native (supplemented with some small plantings)
Lake Trout Potential Annual Yield.....150 kg or 0.77 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Excessive angler harvest

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Date s)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1982 (June 5-Aug. 25)	5,620.4	28.8	293	1.50
1991 (June 1-Sept. 8)	4,707.0	24.1	n/a	

FISHERIES SUMMARY

Water levels regulated by Gananoque Light & Power Company.

The estimated lake trout harvest is believed to exceed annual production. Although the status of the lake trout fishery in Birch Lake has probably deteriorated, it is still believed to be in good condition.

Future management activities should reduce harvest by means of shorter open seasons, reduced daily catch and possession limits and bait restrictions.

Supplemental stocking will continue but will be reduced or phased out over the long term. In order to provide alternate fisheries and direct pressure away from native stocks in Birch Lake a number of other lakes in the area will be planted with species such as splake, rainbow trout and brook trout.

Negotiations should continue with Gananoque Light & Power Company for the implementation of water level regimes which are favourable to lake trout spawning, egg incubation and early rearing.

Future efforts should also be directed to protecting and enhancing existing lake trout habitat.

SHORELINE DEVELOPMENT

Residences
- permanent..... –
- seasonal.....8
- total.....8

Private Vacant Lots.....n/a
Tourist Establishments
- number.....1
- rooms/cabins.....–
- campsites..... 15

Provincial Park Campsites (interior use only).....2 clusters; total 8
% Shoreline Crown.....77
% Shoreline Patent.....23

Birch Lake is on the northwest boundary of Frontenac Provincial Park.

Bobs Lake (Green Bay)

LOCATION

County ..... Frontenac
Township ..... Bedford
Watershed ..... Rideau River
Angling Division 9

MORPHOMETRY

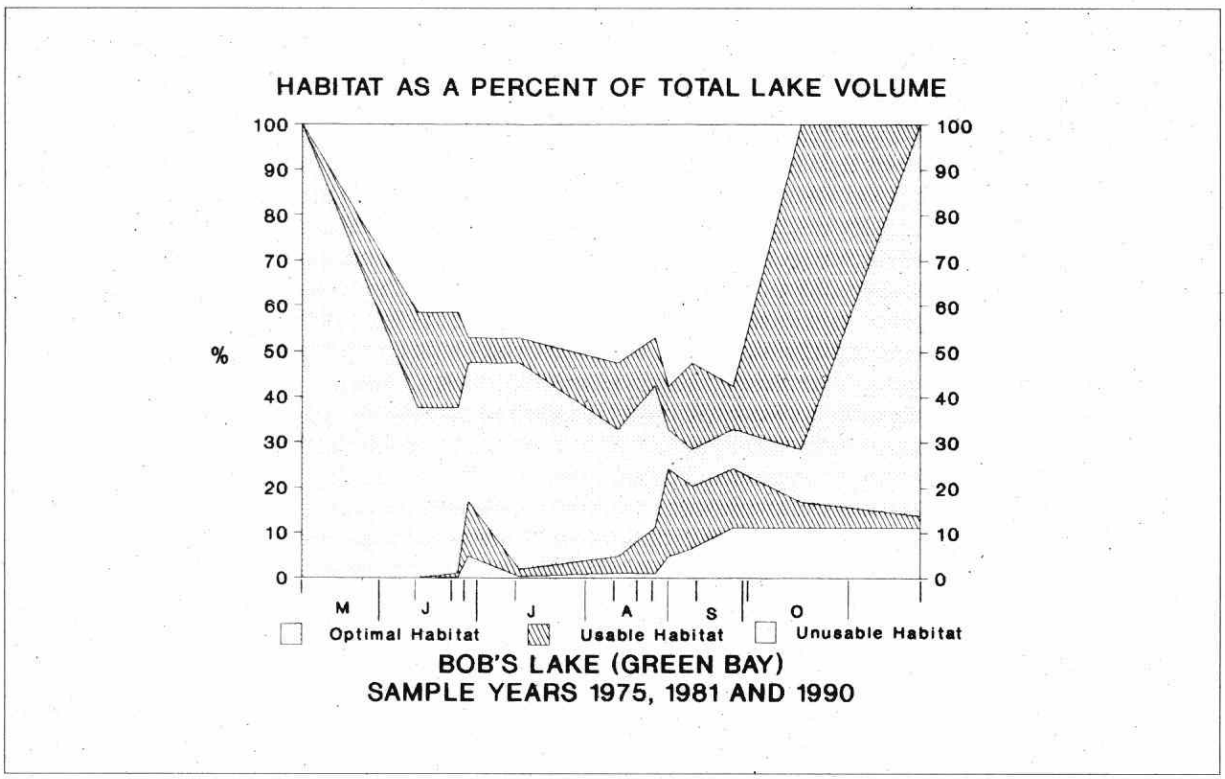
Surface Area ..... 5.34 x $10^6 m^2$
Epilimnion Volume ..... 44.036 x $10^6 m^3$
Hypolimnion Volume ..... 17.472 x $10^6 m^3$
Total Volume ..... 61.508 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 2.502
Maximum Depth ..... 25.6 m
Mean Depth ..... 11.5 m

HYDROLOGY

Watershed Area ..... 21.74 x $10^6 m^2$
Flushing Rate ..... 0.11 times/year
Outflow Volume ..... 6.848 x $10^6 m^3$
Areal Water Load ..... 1.28 m
Retention Coefficient 0.91

WATER QUALITY

Mean Summer Secchi Disc ..... 5.0 m
Chlorophyll a ..... 2.6 µg/L
Total Phosphorus ..... 15.0 µg/L
Total Nitrogen ..... n/a
TDS ..... 123 mg/L
Depth of Water Column - Optimal ..... 2 m
- Usable ..... 8 m
Optimal Habitat as a Percentage of
Total Lake Volume 9
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 31
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index 66
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Bobs Lake (Green Bay) reveal good water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season. The lake trout habitat model predicts that Bobs Lake (Green Bay) is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species .....Lake trout, walleye, northern pike, smallmouth bass, largemouth bass, lake whitefish
Lake Trout Origin .....Native
Lake Trout Potential Annual Yield .....555.2 kg or 0.73 kg/ha
Lake Trout Reproduction.....Limited natural reproduction (holding basin)
Stress Factors .....Nutrient enrichment, habitat loss

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	74.7	0.14	n/a	
1990 (March 10-31)	97.6	0.18	n/a	
1991 (March 9-30)	100.6	0.18	n/a	
(May 19-Sept. 8)	758.8	1.40	n/a	
1992 (March 14-31)	283.2	0.53	n/a	

FISHERIES SUMMARY

Water levels are regulated by Environment Canada, Parks Service (Rideau Canal).

Bobs Lake (Green Bay) presently supports a remnant lake trout population with extremely low levels of natural reproduction. For the past several years Green Bay has been planted with F1 splake.

Future management efforts will be initiated to rehabilitate the remnant lake trout population. This will involve stocking yearling lake trout in an effort to rebuild a naturally reproducing lake trout population. Plantings of F1 splake will be discontinued immediately.

Every effort should be directed to protecting existing habitat and restoring degraded habitat.
Future programs should also be initiated to increase information on the lake trout fishery and the success of rehabilitative stocking programs.

SHORELINE DEVELOPMENT

Residences
- permanent.....–
- seasonal 87
- total 87

Private Vacant Lots 49

Tourist Establishments
- number.....–
- rooms/cabins 48
- campsites.....–

Provincial Park Campsites .....–
% Shoreline Crown.....0
% Shoreline Patent.....100

Buck Lake (North Basin)

LOCATION

County ..... Frontenac
Township ..... Loughborough, Bedford, Storrington
Watershed ..... Cataraqui River
Angling Division 9

MORPHOMETRY

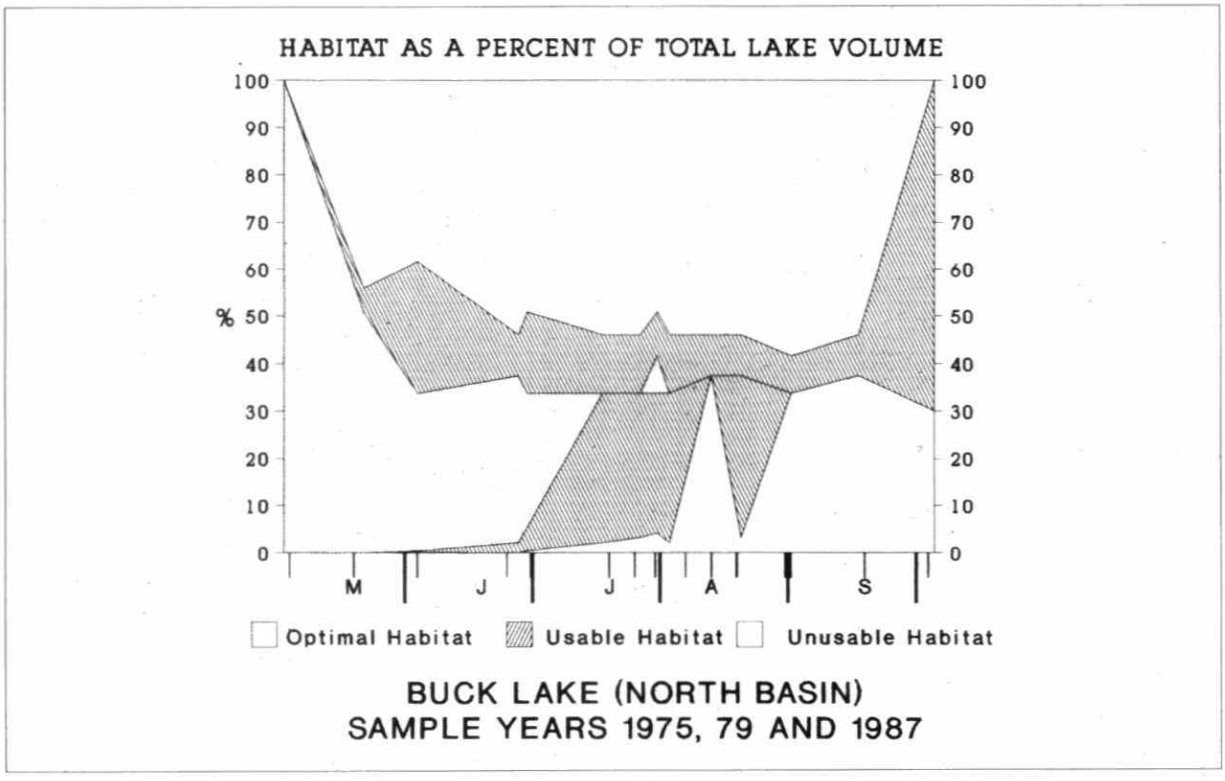
Surface Area ..... 2.64 x $10^6 m^2$
Epilimnion Volume ..... 20.658 x $10^6 m^3$
Hypolimnion Volume ..... 7.571 x $10^6 m^3$
Total Volume ..... 28.299x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 2.729
Maximum Depth ..... 32.0 m
Mean Depth ..... 10.5 m

HYDROLOGY

Watershed Area ..... 10.60x $10^6 m^2$
Flushing Rate ..... 0.12 times/year
Outflow Volume ..... 3.33 x $10^6 m^3$
Areal Water Load ..... 1.3 m
Retention Coefficient 0.91

WATER QUALITY

Mean Summer Secchi Disc ..... 4.4 m
Chlorophyll a ..... 2.8 µg/L
Total Phosphorus ..... 13 µg/L
Total Nitrogen ..... 356 µg/L
TDS 67mg/L
Depth of Water Column - Optimal ..... 0 m
- Usable ..... 0 m
Optimal Habitat as a Percentage of Total Lake Volume 0
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 0
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1975, 1979 and 1987 surveys of Buck Lake (North Basin) reveal poor water quality conditions for lake trout. Average chlorophyll levels are consistently high. Temperature and oxygen profiles indicate optimal lake trout habitat is depleted early in the stratified season.

The lake trout habitat model predicts that Buck Lake (North Basin) is highly sensitive to the loss of the remaining lake trout habitat as a result of additional loadings.

FISHERIES

Major Sport Species.....Lake trout, yellow perch, northern pike,largemouth bass, smallmouth bass
Lake Trout Origin.....Native
Lake Trout Potential Annual Yield
.....261.2 kg or 0.95kg/ha
Lake Trout Reproduction.....Limited natural reproduction
Stress Factors.....Nutrient enrichment and associated habitat loss

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	695.8	2.52	26	0.09
1990 (March 10-31)	1,251.2	4.53	n/a	
1991 (March 9-30)	224.4	0.81	n/a	
(May 19-Sept 8)	3,447.2	12.5	n/a	
1992 (March 14-31)	2,302.6	8.34	n/a	

FISHERIES SUMMARY

Water levels regulated by the Gananoque Light and Power Company.

The north basin of Buck Lake currently supports a small resident population of lake trout. It is believed that movement of lake trout occurs between the north and south basins.

A concerted effort will be directed to maintaining the existing fisheries habitat by regulating shoreline development, minimizing adverse impacts from water drawdowns and restricting nutrient imputs.

F1 splake stocking will be discontinued immediately and lake trout plantings will be initiated to rehabilitate the resident lake trout population.

It is recommended that programs be instituted to document angling pressure and harvest as well as the status of the lake trout fishery.

SHORELINE DEVELOPMENT

Residences
- permanent.....–
- seasonal.....77
- total.....77

Private Vacant Lots.....49

Tourist Establishments
- number.....1
- rooms/cabins.....–
- campsites.....20

Provincial Park Campsites.....1 cluster of 4
% Shoreline Crown.....10
% Shoreline Patent.....90

The lake forms part of the southeast boundary of Frontenac Provincial Park.

Buck Lake (South Basin)

LOCATION

County.....Frontenac
Township.....Loughborough, Bedford, Storrington
Watershed.....Cataraqui River
Angling Division.....9

MORPHOMETRY

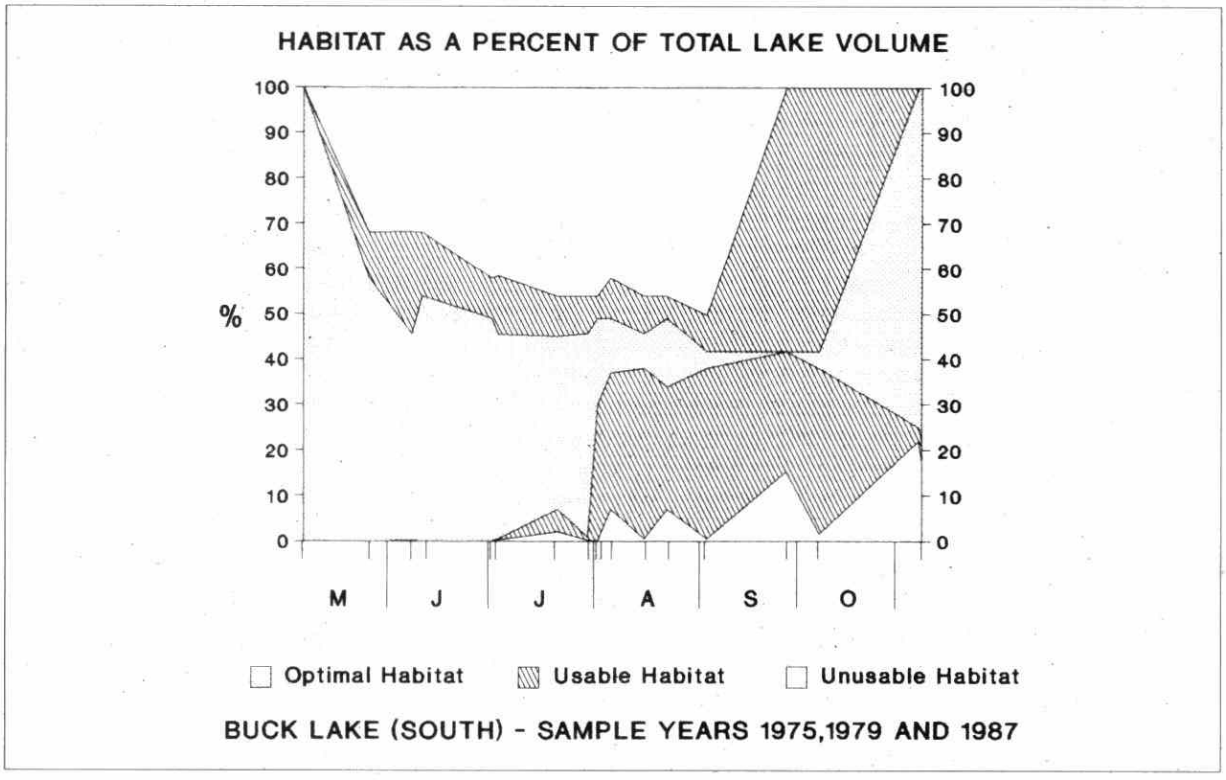
Surface Area.....4.910 x $10^6 m^2$
Epilimnion Volume.....38.139 x $10^6 m^3$
Hypolimnion Volume.....22.851 x $10^6 m^3$
Total Volume.....60.990 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion.....1.669
Maximum Depth.....41.0 m
Mean Depth.....12.4 m

HYDROLOGY

Watershed Area.....51.28 x $10^6 m^2$
Flushing Rate.....0.28 times/year
Outflow Volume.....16.96 x $10^6 m^3$
Areal Water Load.....3.45 m
Retention Coefficient.....0.78

WATER QUALITY

Mean Summer Secchi Disc.....54.3 m
Chlorophyll a.....2.3 µg/L
Total Phosphorus.....12 µg/L
Total Nitrogen.....392 µg/L
TDS.....92.95 mg/L
Depth of Water Column - Optimal.....3 m
- Usable.....22 m
Optimal Habitat as a Percentage of Total Lake Volume.....12
Aug. 31 (≤ 10°C & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume.....51
Aug. 31 (≤ 15.5°C & ≥ 4 ppm O_2)
Sensitivity Index.....21
Classification.....Moderately Sensitive



WATER QUALITY SUMMARY

Surveys of Buck Lake (South Basin) reveal good water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat is present throughout the stratified season.

According to the lake trout habitat model predictions, the south basin of Buck Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass, northern pike
Lake Trout Origin.....Native (supplemented with regular plantings)
Lake Trout Potential Annual Yield
.....422 kg or 0.86 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Excessive angler harvest and degraded spawning beds

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1991 (June 1-Sept. 8)	5,452.8	11.1	n/a	

FISHERIES SUMMARY

Water levels are controlled by the Gananoque Light and Power Company.

Despite a decline in their status, the resident lake trout population is still believed to be in reasonably good condition.

Future management should include efforts to reduce angler harvest by shorter open seasons, reduced daily catch and possession limits and /or bait restrictions.

Supplemental stocking will continue but will be reduced or phased out over the long term. In order to provide alternate fisheries and direct fishing pressure away from native stocks in Buck Lake a number of other lakes in the area will be planted with species such as splake, rainbow trout and brook trout.

Negotiations should continue with Gananoque Light & Power Company for improved water level regimes on Buck Lake which are favourable for lake trout spawning, egg incubation and early rearing.

Efforts should also be made to protect existing water quality and lake trout habitat as well as enhance spawning shoals on Buck Lake.

SHORELINE DEVELOPMENT

Residences
- permanent.....15
- seasonal.....176
- total.....191

Private Vacant Lots.....87

Tourist Establishments
- number.....2
- rooms/cabins.....10
- campsites.....–

Provincial Park Campsites.....–
% Shoreline Crown.....–
% Shoreline Patent.....100

Canoe Lake

LOCATION

County ..... Frontenac
Township ..... Bedford
Watershed ..... Cataraqui River
Angling Division 9

MORPHOMETRY

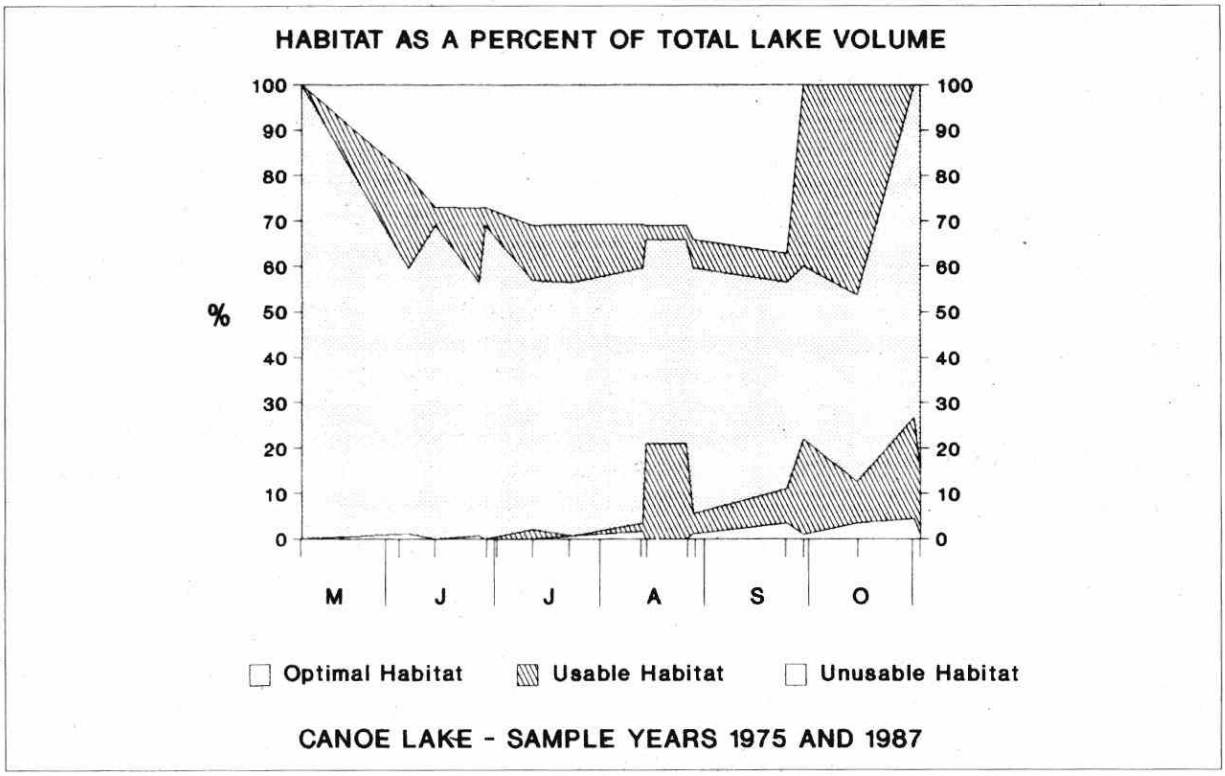
Surface Area ..... 2.910 x $10^6 m^2$
Epilimnion Volume ..... 28.840 x $10^6 m^3$
Hypolimnion Volume ..... 37.850 x $10^6 m^3$
Total Volume ..... 66.690 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 0.762
Maximum Depth ..... 47.0 m
Mean Depth ..... 22.9 m

HYDROLOGY

Watershed Area ..... 23.72 x $10^6 m^2$
Flushing Rate ..... 0.12 times/year
Outflow Volume ..... 7.85 x $10^6 m^3$
Areal Water Load ..... 2.69 m
Retention Coefficient 0.82

WATER QUALITY

Mean Summer Secchi Disc ..... 8.2 m
Chlorophyll a ..... 1.8 µg/L
Total Phosphorus ..... 11.0 µg/L
Total Nitrogen ..... 285 µg/L
TDS ..... 111.80 mg/L
Depth of Water Column - Optimal ..... 18 m
- Usable ..... 35 m
Optimal Habitat as aPercentage of
Total Lake Volume 45
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 69
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index 35
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

The 1975 and 1987 surveys of Canoe Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Canoe Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass, northern pike
Lake Trout Origin.....Native (supplemented by small, regular plantings)
Lake Trout Potential Annual Yield
.....201 kg or 0.69 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Excessive angler harvest

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1977 (June 6-Aug. 17)	10,616.0	36.5	509	0.80
1991 (June 1-Sept. 8)	5,810.2	20.0	n/a	

FISHERIES SUMMARY

Water levels are controlled by Gananoque Light and Power Company.

Although the status of the lake trout population has declined it is still believed to be in relatively good condition.

Future management activities on Canoe Lake should involve reducing the annual lake trout harvest by means such as shortened seasons, reduced daily catch and possession limits and/or bait restrictions. Supplemental stocking will continue but will be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from native lake trout stocks in Canoe Lake, a number of other lakes in the area will be planted with species such as splake, brook trout and rainbow trout.

Negotiations should continue with Gananoque Light and Power for improved water level regimes on Canoe Lake which are favourable for lake trout spawning, egg incubation and early rearing. Efforts should also be directed to protecting/enhancing existing lake trout habitat.

SHORELINE DEVELOPMENT

Residences
- permanent.....3
- seasonal.....21
- total.....24

Private Vacant Lots.....26

Tourist Establishments
- number.....2
- rooms/cabins.....7
- campsites.....77

Provincial Park Campsites.....–
% Shoreline Crown.....23
% Shoreline Patent.....77

Charleston Lake

LOCATION

County.....Leeds
Township.....Rear of Leeds and Lansdowne, Rear of Yonge and Escott, Front of Leeds & Lansdowne, Front of Escott
Watershed.....Gananoque River
Angling Division.....10

MORPHOMETRY

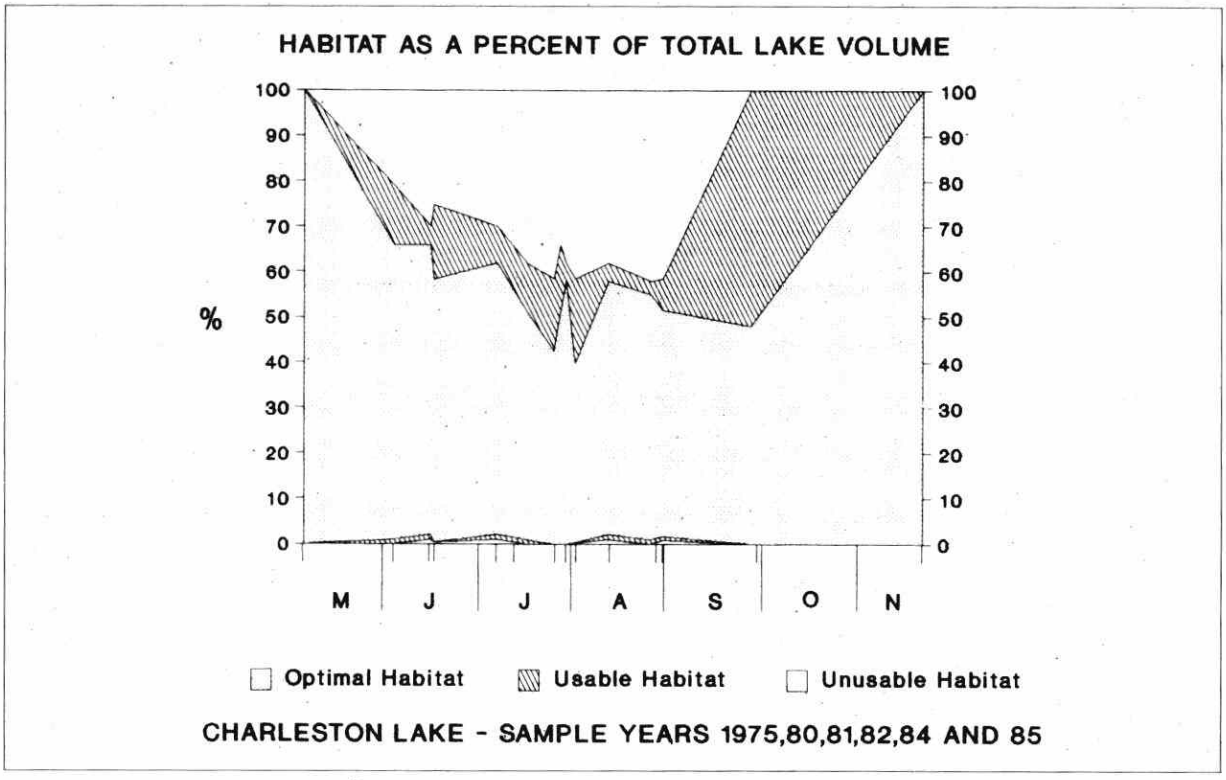
Surface Area.....25.170 x $10^6 m^2$
Epilimnion Volume.....224.700 x $10^6 m^3$
Hypolimnion Volume.....208.800 x $10^6 m^3$
Total Volume.....433.500 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion.....1.076
Maximum Depth.....91.2 m
Mean Depth.....17.2 m

HYDROLOGY

Watershed Area.....302.11 x $10^6 m^2$
Flushing Rate.....0.24 times/year
Outflow Volume.....102.85 x $10^6 m^3$
Areal Water Load.....4.09 m
Retention Coefficient.....0.75

WATER QUALITY

Mean Summer Secchi Disc.....4.6 m
Chlorophyll a.....3.0 µg/L
Total Phosphorus.....22.0 µg/L
Total Nitrogen.....427 µg/L
TDS.....141.05 mg/L
Depth of Water Column - Optimal.....70 m
- Usable.....84 m
Optimal Habitat as a Percentage of Total Lake Volume.....48
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume.....66
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index.....4
Classification.....Moderately Sensitive



WATER QUALITY SUMMARY

Surveys of Charleston Lake reveal excellent water quality conditions for lake trout. Although average chlorophyll levels are greater than for most of the other lake trout lakes, the temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season. According to the lake trout habitat model predictions, Charleston Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass, northern pike
Lake Trout Origin .....Native (supplemented with annual plantings)
Lake Trout Potential Annual Yield .....2240 kg or 0.89 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors .....Excessive angler harvest, adverse water fluctuations, loss and degradation of spawning beds

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1977 (June 6-Sept. 9)	n/a		1,488	n/a
1981 (June 6-Sept. 8)	64,511.0	25.6	5,365	2.71
1983 (June 4-Sept. 8)	74,182.0	29.5	9,480	4.80
1985 (June 1-Sept. 8)	83,399.0	33.1	9,291	3.84
1987 (June 6-Sept. 8)	69,508.0	27.6	5,461	3.04
1991 (June 1-Sept. 8)	111,155.0	44.2	n/a	

FISHERIES SUMMARY

Water levels are regulated by Gananoque Light and Power Company.

Charleston Lake supports a popular lake trout fishery which, although it has deteriorated, is still in reasonably good condition. Future management efforts should be directed at reducing angler harvest by means such as shorter open seasons, reduced daily catch and possession limits and/or bait restrictions.

Supplemental lake trout stocking will continue but may be reduced or phased out over the long term. On an experimental basis, eggs from resident lake trout will be collected, hatched and reared with yearling fish being planted back into Charleston Lake.

In order to provide alternate fisheries and divert fishing pressure away from native lake trout stocks in Charleston Lake , a number of other lakes in the area will be planted with species such as splake, rainbow trout and brook trout.

Negotiations should continue with Gananoque Light and Power for improved water level regimes on Charleston Lake which are favourable for lake trout spawning, egg incubation and early rearing.

Efforts should be made to protect existing lake trout habitat and rehabilitate degraded habitat. Fisheries assessment efforts by the Rideau Lakes Fisheries Assessment Unit will be continued.

SHORELINE DEVELOPMENT

Residences
- permanent.....34
- seasonal 410
- total.....444

Private Vacant Lots.....142

Tourist Establishments
- number.....12
- rooms/cabins.....55
- campsites.....56

Provincial Park Campsites 250
% Shoreline Crown 20
% Shoreline Patent 80

Crow Lake

LOCATION

County ..... Frontenac
Township ..... Oso, Bedford
Watershed ..... Rideau River
Angling Division 9

MORPHOMETRY

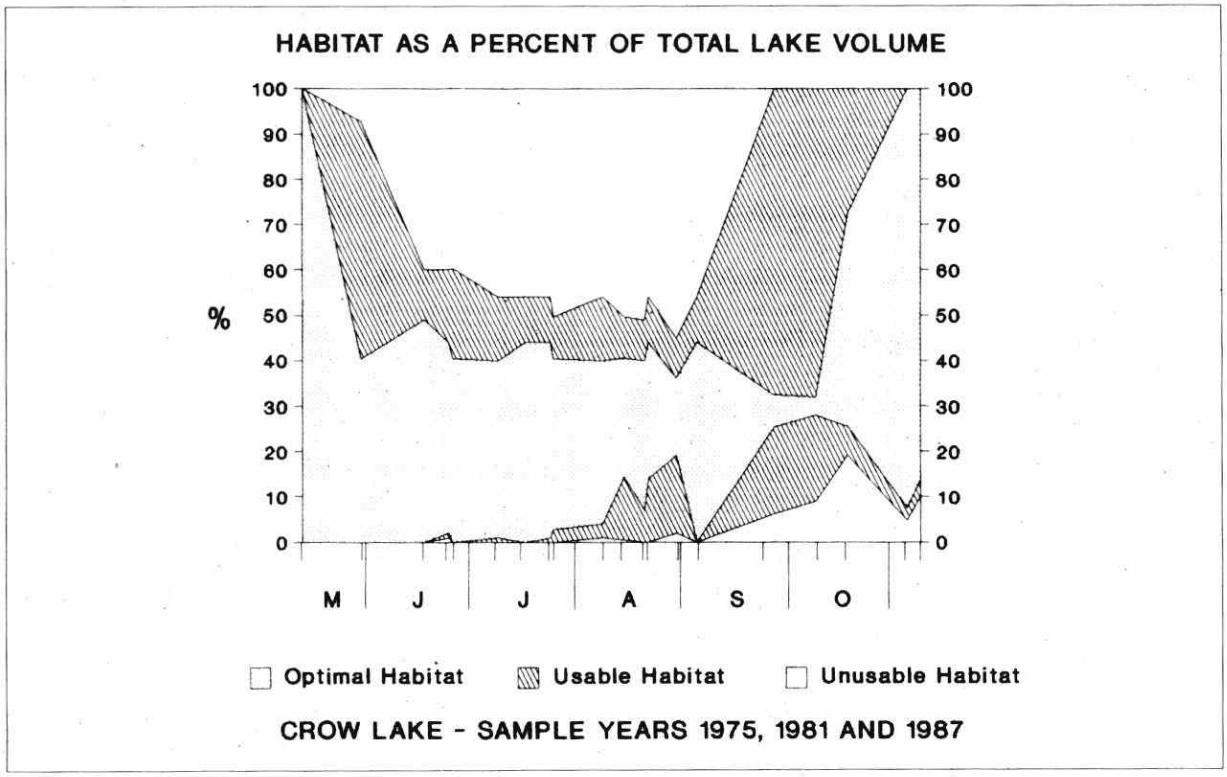
Surface Area ..... 4.420 x $10^6 m^2$
Epilimnion Volume ..... 38.480 x $10^6 m^3$
Hypolimnion Volume ..... 21.270 x $10^6 m^3$
Total Volume ..... 59.750 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.809
Maximum Depth ..... 38.0 m
Mean Depth ..... 13.5 m

HYDROLOGY

Watershed Area ..... 49.03 x $10^6 m^2$
Flushing Rate ..... 0.27 times/year
Outflow Volume ..... 16.28 x $10^6 m^3$
Areal Water Load ..... 3.68 m
Retention Coefficient 0.78

WATER QUALITY

Mean Summer Secchi Disc ..... 4.4 m
Chlorophyll a ..... 1.8 µg/L
Total Phosphorus ..... 21.0 µg/L
Total Nitrogen ..... 342 µg/L
TDS ..... 89.70 mg/L
Depth of Water Column - Optimal ..... 6 m
- Usable ..... 22 m
Optimal Habitat as a Percentage of
Total Lake Volume 21
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 49
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index 21
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

The 1975, 1981 and 1987 surveys of Crow Lake reveal good water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Crow Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass, walleye, northern pike
Lake Trout Origin.....Native (supplemented by regular plantings)
Lake Trout Potential Annual Yield .....358 kg or 0.81 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Adverse water level fluctuations, deterioration of spawning beds and introduction of undesirable fish species

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1991 (June 1-Sept. 8)	3,544.0	8.0	n/a	

FISHERIES SUMMARY

Water levels controlled by Environment Canada Parks Service (Rideau Canal).

The status of the resident lake trout population is believed to be fair.

Future management activities on Crow Lake should involve negotiations with the Parks Service for improved water level regimes which are favourable for lake trout spawning, egg incubation and early rearing. Efforts should also be made to protect existing habitat as well as rehabilitate degraded spawning shoals.

In order to protect the resident lake trout fishery from overharvest, shorter seasons, reduced daily catch and possession limits and bait restrictions may be necessary.

Supplemental lake trout stocking in Crow Lake will continue but may re reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from native lake trout stocks in Crow Lake, a number of other lakes in the area will be planted with species such as splake, rainbow trout and brook trout.

Programs should also be initiated to establish baseline fishing pressure and harvest data in Crow Lake.

SHORELINE DEVELOPMENT

Residences
- permanent 11
- seasonal 78
- total 89

Private Vacant Lots 38
Tourist Establishments
- number 6
- rooms/cabins 37
- campsites 31

Provincial Park Campsites .....–
% Shoreline Crown.....15
% Shoreline Patent.....85

With the exception of the southeast shore, the lake is well developed with small, narrow cottage lots, most of which are cleared and/or have lawns and gardens.

Crystal Lake

LOCATION

County ..... Lennox and Addington
Township ..... Ashby
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

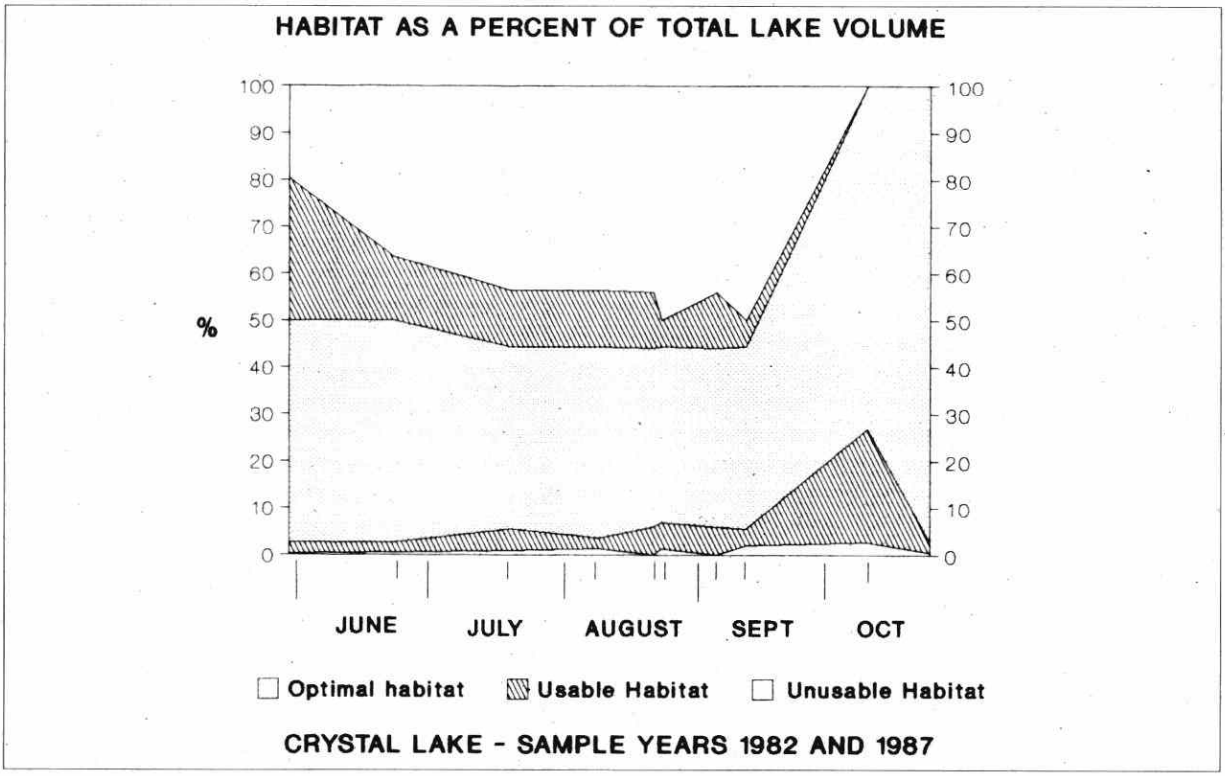
Surface Area ..... 0.500 x $10^6 m^2$
Epilimnion Volume ..... 3.100 x $10^6 m^3$
Hypolimnion Volume ..... 1.590 x $10^6 m^3$
Total Volume ..... 4.690 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.950
Maximum Depth ..... 32.0 m
Mean Depth ..... 9.4 m

HYDROLOGY

Watershed Area ..... 3.53 x $10^6 m^2$
Flushing Rate ..... 0.24 times/year
Outflow Volume ..... 1.15 x $10^6 m^3$
Areal Water Load ..... 2.29 m
Retention Coefficient 0.86

WATER QUALITY

Mean Summer Secchi Disc ..... 5.3 m
Chlorophyll a ..... 1.0 µg/L
Total Phosphorus ..... 8.0 µg/L
Total Nitrogen ..... 160 µg/L
TDS ..... 20.80 mg/L
Depth of Water Column - Optimal ..... 15 m
- Usable ..... 23 m
Optimal Habitat as a Percentage of Total Lake Volume 38
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 55
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm O_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1982 and 1987 surveys of Crystal Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season. The lake trout habitat model predicts that Crystal Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout
Lake Trout Origin.....Native
(lake trout have never been planted)
Lake Trout Potential Annual Yield
.....24 kg or 0.47 kg/ha

Lake Trout Reproduction.....Significant
natural reproduction
Stress Factors.....Acidic precipitation
(lake is poorly buffered), overharvest

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	358.9	7.2	106	0.61
1990 (March 10-31)	345.2	6.9	183	0.99
1991 (March 9-31)	1,938.4	38.8	n/a	
(May 19-Sept. 8)	1,646.4	32.9	n/a	
1992 (March 14-31)	1,606.9	32.1	n/a	

FISHERIES SUMMARY

Natural water level regime.

Resident lake trout population believed to be in reasonably good condition.

Future management efforts on Crystal Lake should include collecting baseline fishing pressure and harvest data, protecting existing lake trout habitat and examining acidification mitigative techniques.

In order to protect the resident lake trout population from overexploitation it may be necessary to shorten open seasons, reduce daily catch and possession limits and impose bait restrictions.

Efforts should be directed to maintaining or enhancing the resident lake trout population without stocking. In order to provide alternate fisheries and divert angling pressure away from lake trout stocks in Crystal Lake, a number of other lakes in the area will be planted with species such as splake, rainbow trout and brook trout.

SHORELINE DEVELOPMENT

Crystal Lake is situated in a large block of undeveloped Crown land.

Desert Lake

LOCATION

County ..... Frontenac
Township ..... Bedford, Loughborough
Watershed ..... Cataraqui River
Angling Division 9

MORPHOMETRY

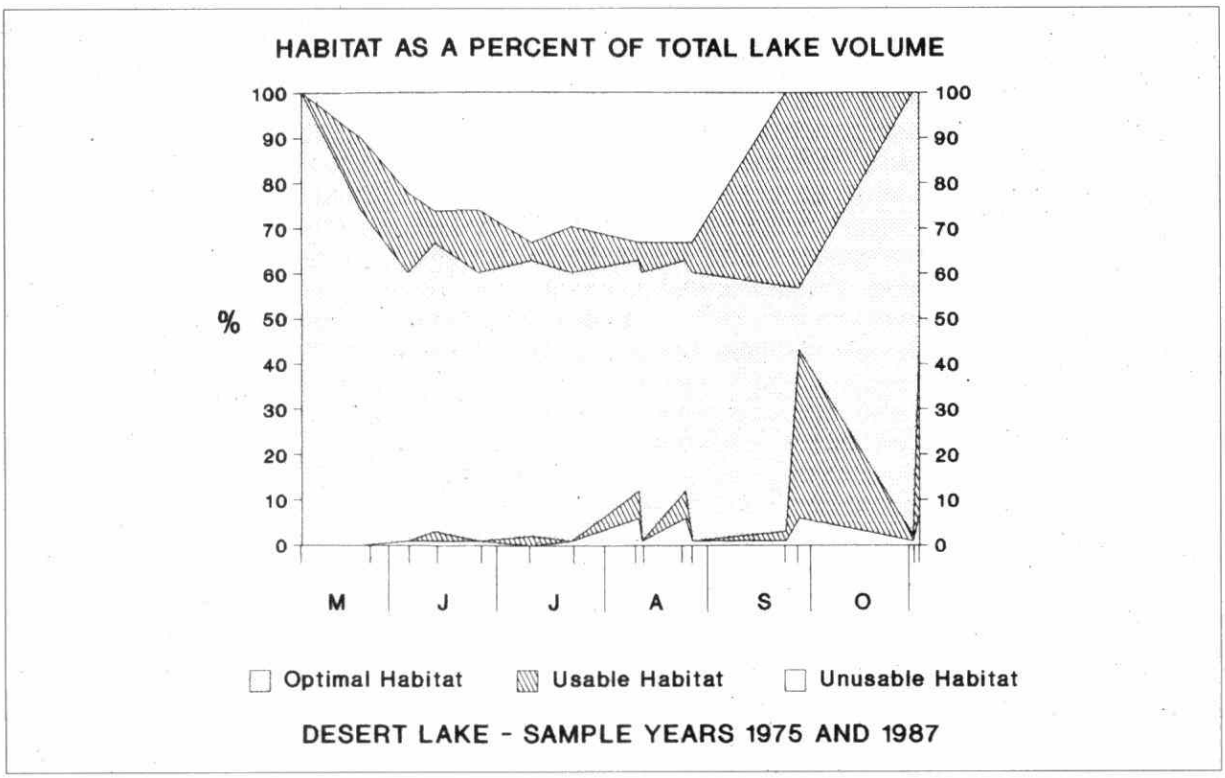
Surface Area ..... 4.020 x $10^6 m^2$
Epilimnion Volume ..... 37.120 x $10^6 m^3$
Hypolimnion Volume ..... 43.980 x $10^6 m^3$
Total Volume ..... 81.100 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 0.844
Maximum Depth ..... 68.0 m
Mean Depth ..... 20.2 m

HYDROLOGY

Watershed Area ..... 104.15 x $10^6 m^2$
Flushing Rate ..... 0.44 times/year
Outflow Volume ..... 36.09 x $10^6 m^3$
Areal Water Load ..... 8.98 m
Retention Coefficient 0.60

WATER QUALITY

Mean Summer Secchi Disc ..... 5.8 m
Chlorophyll a ..... 2.6 µg/L
Total Phosphorus ..... 18.0 µg/L
Total Nitrogen ..... 339 µg/L
TDS ..... 112.45 mg/L
Depth of Water Column - Optimal ..... 26 m
- Usable ..... 37 m
Optimal Habitat as a Percentage of Total Lake Volume 32
Aug. 31 (≤ 10°C & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 61
Aug. 31 (≤ 15.5°C & ≥ 4 ppm O_2)
Sensitivity Index 21
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

The 1975 and 1987 surveys of Desert Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Desert Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass, northern pike
Lake Trout Origin ....Native (supplemented by regular plantings)

Lake Trout Potential Annual Yield .....297 kg or 0.74 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors .....Excessive angler harvest

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1977 (June 6-Aug. 17)	11,366.0	28.3	838	1.23
1982 (June 5-Aug. 25)	8,430.5	21.0	816	1.28
1991 (June1-Sept. 8)	8,898.9	22.1	n/a	

FISHERIES SUMMARY

Water levels controlled by Gananoque Light and Power Company.

Although the resident lake trout population is over-harvested, its present status is believed to be reasonably good. Future management efforts should be directed to reducing harvest by means of shorter open seasons, reduced daily catch and possession limits and/or bait restrictions.

Supplemental lake trout stocking will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries and divert angling pressure away from lake trout stocks in Desert Lake, a number of other local lakes will be planted with species such as splake, brook trout and rainbow trout.

Negotiations should continue with Gananoque Light and Power Company for improved water level regimes which are favourable for lake trout spawning, egg incubation and early rearing.

Future efforts should also be directed to protecting existing fisheries habitat and implementing programs to establish baseline fishing pressure and harvest data.

SHORELINE DEVELOPMENT

Residences
- permanent 12
- seasonal 57
- total 69

Private Vacant Lots 32

Tourist Establishments
- number 4
- rooms/cabins 27
- campsites 115

Provincial Park Campsites .....–
% Shoreline Crown 0
% Shoreline Patent 100

Devil Lake

LOCATION

County ..... Frontenac
Township ..... Bedford
Watershed ..... Cataraqui River
Angling Division 9

MORPHOMETRY

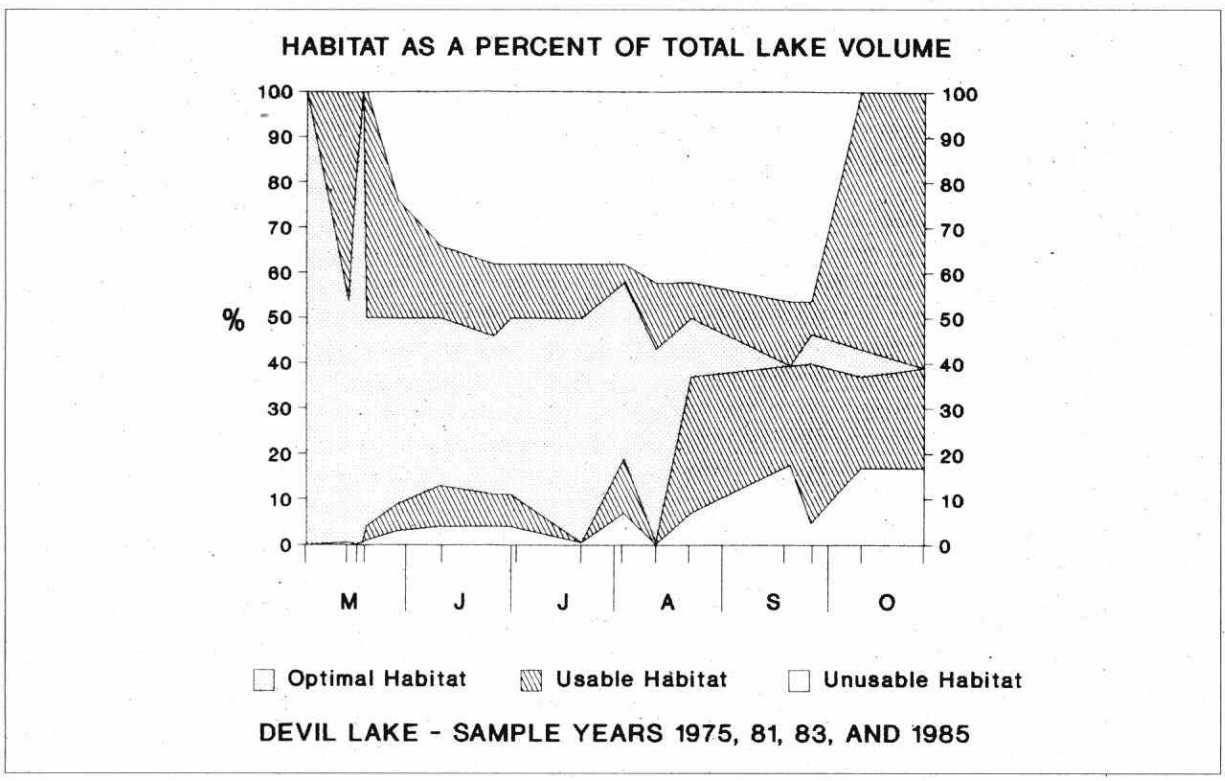
Surface Area ..... 10.620 x $10^6 m^2$
Epilimnion Volume ..... 86.822 x $10^6 m^3$
Hypolimnion Volume ..... 65.378 x $10^6 m^3$
Total Volume ..... 152.200 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.328
Maximum Depth ..... 45.0 m
Mean Depth ..... 14.3 m

HYDROLOGY

Watershed Area ..... 174.49 x $10^6 m^2$
Flushing Rate ..... 0.40 times/year
Outflow Volume ..... 61.52 x $10^6 m^3$
Areal Water Load ..... 5.79 m
Retention Coefficient 0.68

WATER QUALITY

Mean Summer Secchi Disc ..... 5.5 m
Chlorophyll a ..... 2.3 µg/L
Total Phosphorus ..... 15.0 µg/L
Total Nitrogen ..... 318 µg/L
TDS ..... 110.50 mg/L
Depth of Water Column - Optimal ..... 11 m
- Usable ..... 58 m
Optimal Habitat as a Percentage of Total Lake Volume 29
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 58
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm O_2)
Sensitivity Index 8
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

Surveys of Devil Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Devil Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass, northern pike
Lake Trout Origin .....Native (supplemented by regular plantings)
Lake Trout Potential Annual Yield .....924 kg or 0.87 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors.....Excessive angler harvest and adverse water level fluctuations

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1978 (May 4-Sept. 8)	36,126.0	34.0	1,193	0.95
1981 (June 6-Sept. 8)	21,121.0	19.9	1,845	2.62
1983 (June 4-Sept. 8)	25,571.0	24.1	2,276	3.18
1987 (June 6-Sept. 8)	28,040.0	26.4	2,085	2.14
1990 (May-Sept.)	20,618.4	19.4	n/a	
1991 (June 1-Sept. 8)	25,531.0	24.0	1,864	2.31

FISHERIES SUMMARY

Water levels controlled by Gananoque Light and Power Company.

Devil Lake is being monitored (long-term) by Rideau Lakes Fisheries Assessment Unit.

Despite an estimated over-harvest, the Devil Lake lake trout population is still believed to be in reasonably good condition. Future management activities should be directed to reducing angler harvest by means of shorter open seasons, reduced daily catch and possession limits and/or bait restrictions.

Supplemental lake trout plantings will continue but may be reduced or phased out over the longer term. An experimental stocking program, involving the use of "native" strain fish, will be implemented on a trial basis. In order to provide alternate fisheries and divert angling pressure away from lake trout stocks in Devil Lake a number of other local lakes will be planted with fish species including splake, brook trout and rainbow trout.

Negotiations should continue with Gananoque Light and Power Company for improved water level regimes which are favourable for lake trout spawning, egg incubation and early rearing. In addition , effort should be made to protect existing fisheries habitat.

Fisheries assessment efforts by the Rideau Lakes Fisheries Assessment Unit will be continued.

SHORELINE DEVELOPMENT

Residences
- permanent 21
- seasonal 188
- total 209

Private Vacant Lots 80
Tourist Establishments
- number 4
- rooms/cabins 19
- campsites 49

Provincial Park Campsites (interior use only) .....1 cluster of 4
% Shoreline Crown 20
% Shoreline Patent 80

The lake forms part of the northeast boundary of Frontenac Provincial Park.

Dickey Lake

LOCATION

County ..... Hastings
Township ..... Lake
Watershed ..... Beaver Creek (Trent River System)
Angling Division 7

MORPHOMETRY

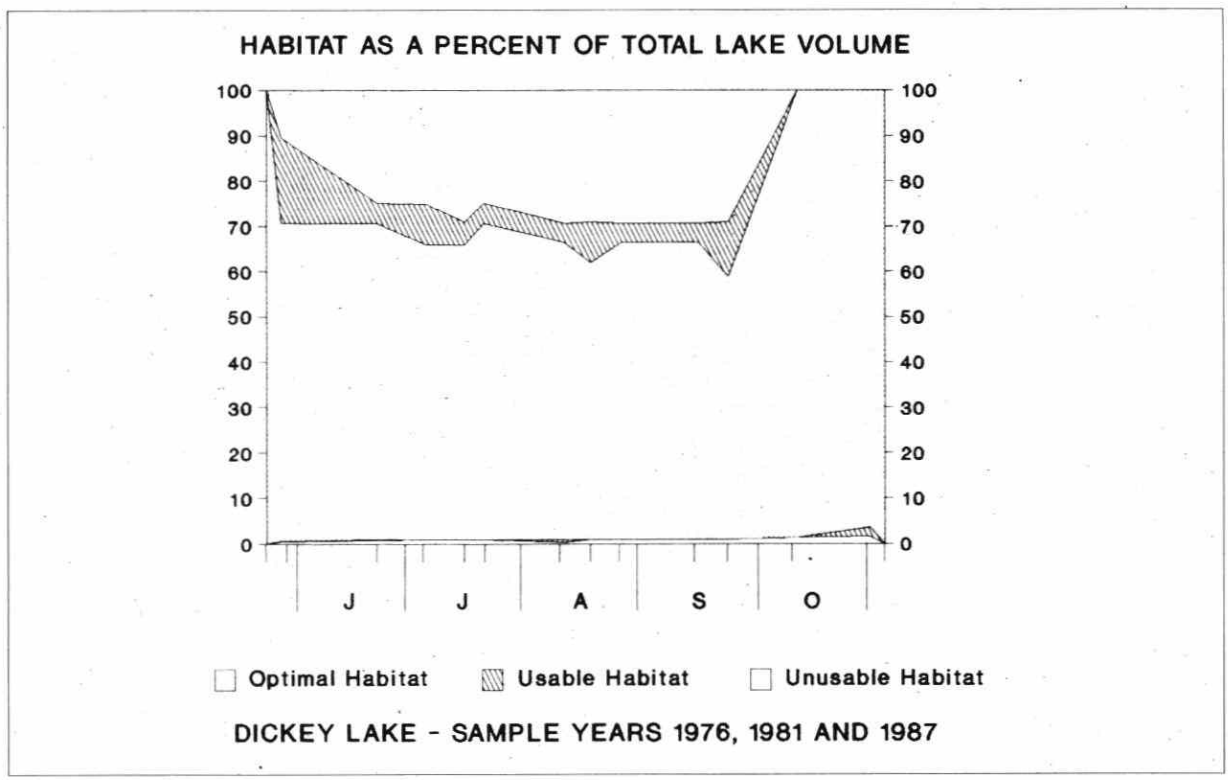
Surface Area ..... $2.080 \times 10^6 m^2$
Epilimnion Volume ..... $17.220 \times 10^6 m^3$
Hypolimnion Volume ..... $20.710 \times 10^6 m^3$
Total Volume ..... $37.930 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 0.831
Maximum Depth ..... 51.0 m
Mean Depth ..... 18.2 m

HYDROLOGY

Watershed Area ..... $54.50 \times 10^6 m^2$
Flushing Rate ..... 0.49 times/year
Outflow Volume ..... $18.44 \times 10^6 m^3$
Areal Water Load ..... 8.45 m
Retention Coefficient 0.61

WATER QUALITY

Mean Summer Secchi Disc ..... 5.2 m
Chlorophyll a ..... 1.0 µg/L
Total Phosphorus ..... 8.0 µg/L
Total Nitrogen ..... 356 µg/L
TDS ..... 89.05 mg/L
Depth of Water Column - Optimal ..... 42 m
- Usable ..... 45 m
Optimal Habitat as a Percentage of Total Lake Volume 58
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 71
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm O_2)
Sensitivity Index 12
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

The 1976, 1981 and 1987 surveys of Dickey Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season. According to the lake trout habitat model predictions, Dickey Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin.....Native
(supplemented by small, irregular plantings)
Lake Trout Potential Annual Yield
.....144 kg or 0.69 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Overexploitation

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1981 (Winter)	2,007.3	9.4	365	0.62
(Open Water)	3,225.0	5.1	192	0.50
1982 (Winter)	2,379.7	11.1	289	0.60
(Open Water)	2,794.8	13.1	281	0.55
1983 (Winter)	2,705.0	12.6	223	0.57
1984 (Winter)	2,416.1	11.3	169	0.31
(Open Water)	2,294.1	10.7	181	0.43
1985 (Winter)	3,317.0	15.5	387	0.76
1986 (Open Water)	1,784.8	8.3	371	0.64
1987 (Winter)	3,845.6	18.0	736	1.08
(Open Water)	1,055.0	4.9	172	0.35
1988 (Winter)	3,543.8	16.6	288	0.53
(Open Water)	993.0	4.6	109	0.27
1989 (Winter)	5,108.2	23.9	465	1.04
(Open Water)	896.7	4.2	158	0.34
1990 (Winter)	4,188.0	19.6	478	0.82
(Open Water)	1,129.9	5.3	111	0.20
1991 (Jan. 1-April 5)	2,636.5	12.3	291	0.47
(April 17-Sept. 30)	348.8	1.6	51	0.15

FISHERIES SUMMARY

Natural water level regime. Annual harvest (497 fish; 216 kg) is believed to exceed production.

The lake is being monitored (long term) by the Haliburton-Hastings Fisheries Assessment Unit.

Although the status of this lake trout population has probably declined in recent years, it is still believed to be in relatively good condition. Future management activities should involve reducing the harvest as well as protecting and enhancing existing habitat.

Supplemental lake trout stocking will continue but maybe reduced or phased out over the long term. In order to provide alternate fisheries and divert angling pressure away from lake trout stocks in Dickey Lake, a number of local lakes will be planted with splake.

Fisheries assessment efforts by the Haliburton-Hastings Fisheries Assessment Unit will continue.

SHORELINE DEVELOPMENT

Residences
- permanent.....–
- seasonal.....141
- total.....141

Private Vacant Lots.....93

Tourist Establishments
- number.....–
- rooms/cabins.....–
- campsites.....–

Provincial Park Campsites.....–
% Shoreline Crown.....35
% Shoreline Patent.....65

Eagle Lake

LOCATION

County ..... Frontenac
Township ..... Hinchinbrooke, Olden
Watershed ..... Rideau River
Angling Division 9

MORPHOMETRY

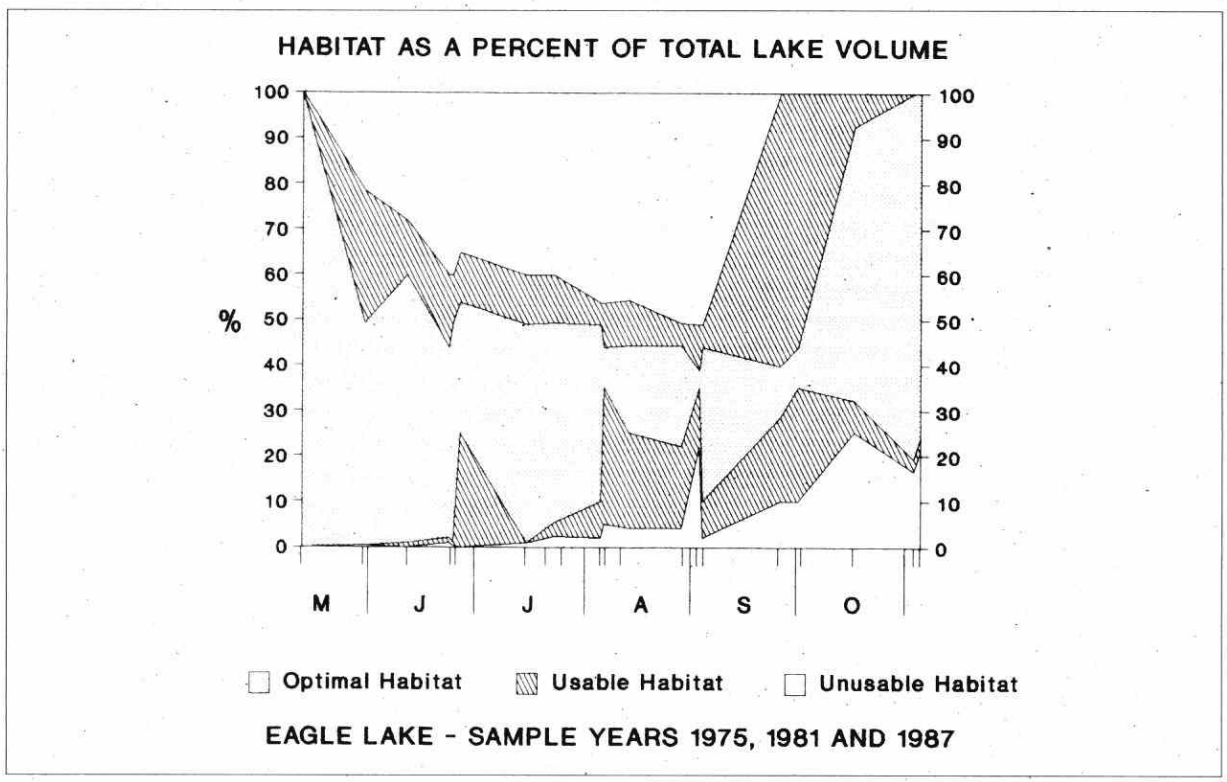
Surface Area ..... 6.460 x $10^6 m^2$
Epilimnion Volume ..... 54.310 x $10^6 m^3$
Hypolimnion Volume ..... 29.570 x $10^6 m^3$
Total Volume ..... 83.880 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.857
Maximum Depth ..... 31.1 m
Mean Depth ..... 13.0 m

HYDROLOGY

Watershed Area ..... 40.10 x $10^6 m^2$
Flushing Rate ..... 0.15 times/year
Outflow Volume ..... 12.68 x $10^6 m^3$
Areal Water Load ..... 1.96 m
Retention Coefficient 0.86

WATER QUALITY

Mean Summer Secchi Disc ..... 5.2 m
Chlorophyll a ..... 2.3 µg/L
Total Phosphorus ..... 18.0 µg/L
Total Nitrogen ..... 369 µg/L
TDS ..... 82.55 mg/L
Depth of Water Column - Optimal ..... 5 m
- Usable ..... 18 m
Optimal Habitat as a Percentage of
Total Lake Volume 19
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 47
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index 29
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

The 1975, 1981 and 1987 surveys of Eagle Lake reveal good water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Eagle Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass, largemouth bass, northern pike
Lake Trout Origin.....Native (supplemented by regular plantings)
Lake Trout Potential Annual Yield .....510 kg or 0.79 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors .....Excessive angler harvest

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1991 (June 1-Sept. 8)	11,545.4	17.9	n/a	

FISHERIES SUMMARY

Water level controlled by Ministry of Natural Resources.

Winter fishing pressure believed to approximate 14,000 angler hours (21 hrs/ha) and to exceed annual production.

Despite declining in recent years, the lake trout fishery of Eagle Lake is still believed to be in relatively good condition. Future management efforts should include reducing the harvest by such means as shorter open seasons, reduced daily catch and possession limits and/or bait restrictions.

Supplemental lake trout planting will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries and direct fishing pressure away from lake trout stocks in Eagle Lake, a number of other local lakes will be planted with fish species including splake, rainbow trout and brook trout.

Efforts should also be made to protect and enhance existing fisheries habitat including the development of a water level rule curve favourable to lake trout spawning, egg incubation and early rearing.

Enforcement programs should be directed at eliminating illegal harvest. Assessment programs should be implemented to establish baseline information on fishing pressure and harvest.

SHORELINE DEVELOPMENT

Residences
- permanent 17
- seasonal.....162
- total 179

Private Vacant Lots.....70
Tourist Establishments
- number .....–
- rooms/cabins.....–
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown.....5
% Shoreline Patent.....95

The lake abutts Highway 38 and is very accessible. Cottages and homes are strung along the shoreline and several islands. Most of the development occurs along the southern shore and on a peninsula reaching towards the middle of the lake.

Effingham Lake

LOCATION

County ..... Lennox and Addington
Township ..... Effingham
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

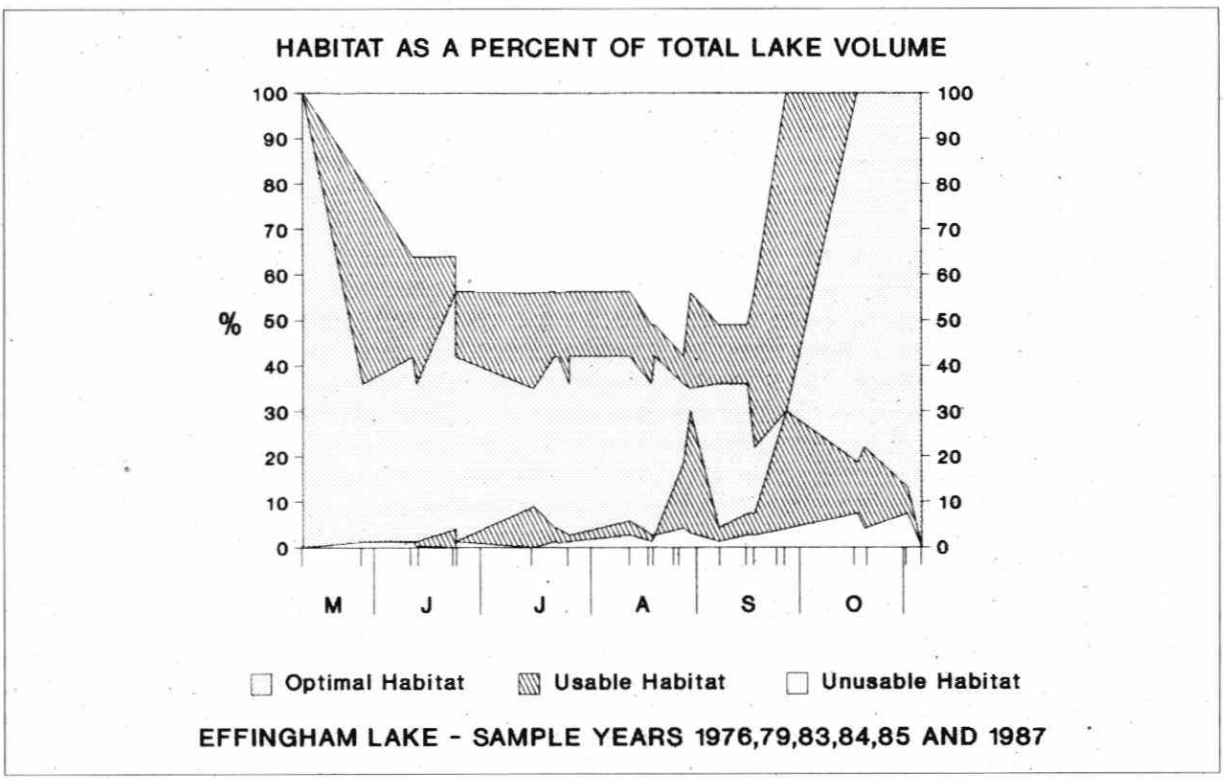
Surface Area ..... 1.970 x $10^6 m^2$
Epilimnion Volume ..... 13.757 x $10^6 m^3$
Hypolimnion Volume ..... 4.720 x $10^6 m^3$
Total Volume ..... 18.477 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 2.915
Maximum Depth ..... 23.0 m
Mean Depth ..... 9.4 m

HYDROLOGY

Watershed Area ..... 47.56 x $10^6 m^2$
Flushing Rate ..... 0.88 times/year
Outflow Volume ..... 16.32 x $10^6 m^3$
Areal Water Load ..... 8.28 m
Retention Coefficient 0.60

WATER QUALITY

Mean Summer Secchi Disc ..... 3.2 m
Chlorophyll a ..... 2.0 µg/L
Total Phosphorus ..... 15.0 µg/L
Total Nitrogen ..... 418 µg/L
TDS ..... 26.65 mg/L
Depth of Water Column - Optimal ..... 4 m
- Usable ..... 14 m
Optimal Habitat as a Percentage of
Total Lake Volume 15
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 46
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Effingham Lake reveal marginal water quality conditions for lake trout. Although average chlorophyll levels are low, temperature and oxygen profiles show limited optimal habitat exists late in the stratified season.

The lake trout habitat model predicts that Effingham Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin.....Native
(Lake Trout have never been planted)
Lake Trout Potential Annual Yield
.....196 kg or 0.54 kg/ha

Lake Trout Reproduction.....Limited
natural reproduction
Stress Factors.....Acidic precipitation
(lake is poorly buffered)

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1990 (March 10-31)	70.6	0.4	10	0.02
1991 (March 9-30)	509.2	2.6	n/a	
(May 19-Sept. 8)	1,125.0	5.7	n/a	
1992 (March 14-31)	357.0	1.8	n/a	

FISHERIES SUMMARY

Natural water level regime.

Future management activities on Effingham Lake should include reducing the harvest by means such as shorter open seasons, reduced daily catch and possession limits and/or bait restrictions.

Efforts should be directed to maintaining or enhancing the resident lake trout population without stocking. In order to provide alternate fisheries and direct fishing pressure away from lake trout stocks in Effingham Lake, a number of local lakes will be planted with fish species including splake, rainbow trout and brook trout.

Efforts should be made to protect existing fisheries habitat and investigate mitigative techniques for lake acidification.

Programs should be implemented to establish baseline inform,ation on fishing pressure and harvest.

SHORELINE DEVELOPMENT

Residences
- permanent.....–
- seasonal.....12
- total.....12

Private Vacant Lots.....–
Tourist Establishments
- number.....–
- rooms/cabins.....–
- campsites.....–

Provincial Park Campsites.....–
% Shoreline Crown.....95
% Shoreline Patent.....5

Fox Lake

LOCATION

County ..... Lennox and Addington
Township ..... Ashby
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

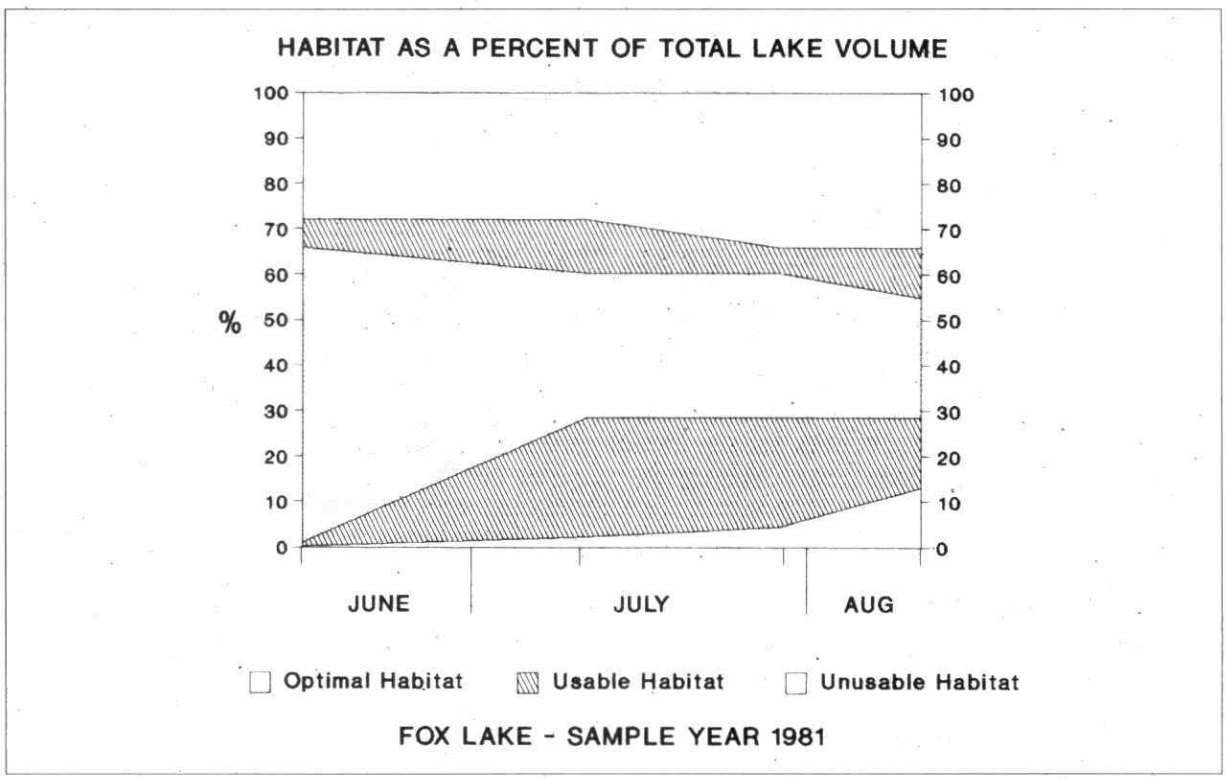
Surface Area ..... $0.270 \times 10^6 m^2$
Epilimnion Volume ..... $2.200 \times 10^6 m^3$
Hypolimnion Volume ..... $1.246 \times 10^6 m^3$
Total Volume ..... $3.446 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.766
Maximum Depth ..... 31.0 m
Mean Depth ..... 13.0 m

HYDROLOGY

Watershed Area ..... $4.38 \times 10^6 m^2$
Flushing Rate ..... 0.44 times/year
Outflow Volume ..... $1.501 \times 10^6 m^3$
Areal Water Load ..... 5.67 m
Retention Coefficient 0.69

WATER QUALITY

Mean Summer Secchi Disc ..... n/a
Chlorophyll a ..... 2.0 µg/L
Total Phosphorus ..... n/a
Total Nitrogen ..... n/a
TDS ..... n/a
Depth of Water Column - Optimal ..... 5.0 m
- Usable ..... 11.0 m
Optimal Habitat as a Percentage of Total Lake Volume 21
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 48
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1981 survey of Fox Lake reveals good water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season. The lake trout habitat model predicts that Fox Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, rainbow trout, smallmouth bass
Lake Trout Origin.....Native (supplemented by some plantings)
Lake Trout Potential Annual Yield
.....15 kg or 0.57 kg/ha
Lake Trout Reproduction.....Limited natural reproduction
Stress Factors.....None identified

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	129.6	4.8	n/a	
1990 (March 10-31)	170.3	6.3	50	0.56
1991 (March 9-31)	755.9	28.0	n/a	
(May 19-Sept. 8)	646.8	24.0	n/a	
1992 (March 14-13)	83.5	3.1	n/a	

FISHERIES SUMMARY

Natural water level regime.

Surveys in 1986 confirmed some lake trout natural reproduction.

Pending more intensive lake trout studies, future management efforts should include phasing out the planting of hatchery reared lake trout, maintaining or enhancing existing habitat, minimizing illegal lake trout harvest and establishing a baseline fisheries data series.

SHORELINE DEVELOPMENT

Fox Lake is surrounded by Crown land. Access to the lake is obtained by walking trail from Ashby Lake.

Gould Lake

LOCATION

County ..... Frontenac
Township ..... Loughborough
Watershed ..... Millhaven Creek
Angling Division 9

MORPHOMETRY

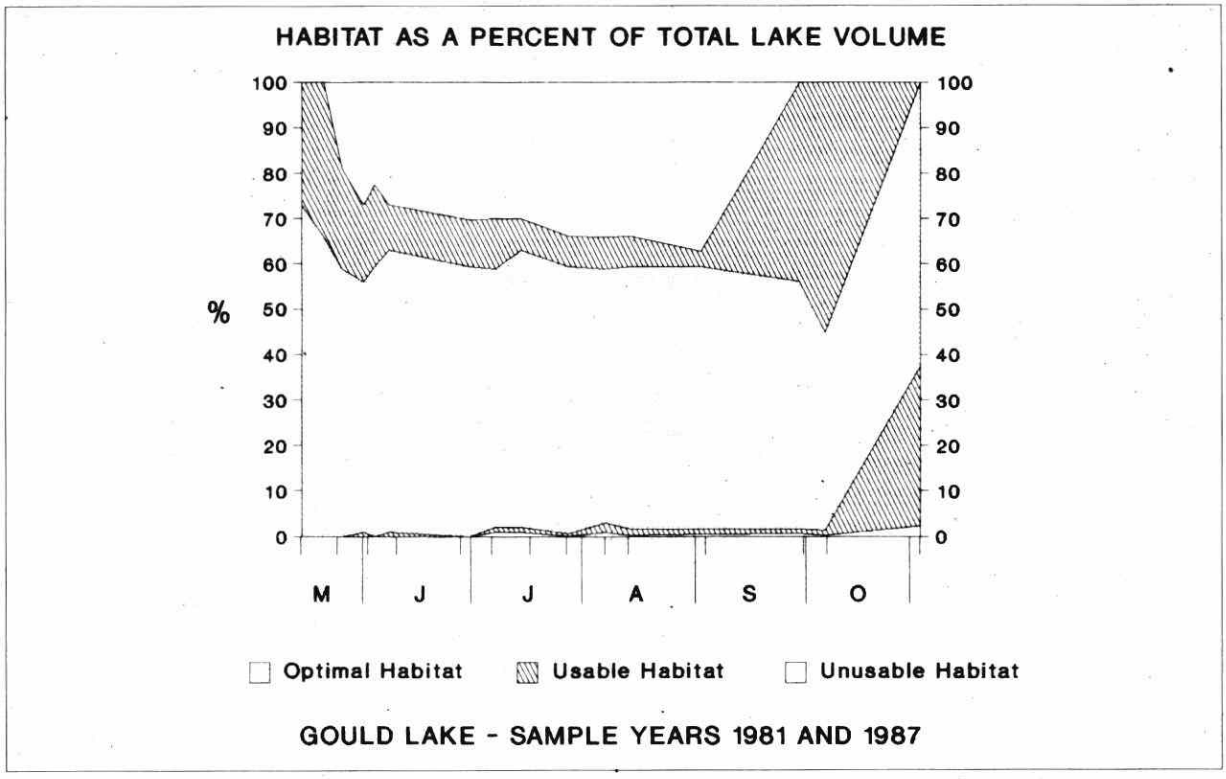
Surface Area ..... $1.990 \times 10^6 m^2$
Epilimnion Volume ..... $17.516 \times 10^6 m^3$
Hypolimnion Volume ..... $22.423 \times 10^6 m^3$
Total Volume ..... $39.939 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 0.781
Maximum Depth ..... 61.0 m
Mean Depth ..... 20.1 m

HYDROLOGY

Watershed Area ..... $10.04 \times 10^6 m^2$
Flushing Area ..... 0.08 times/year
Outflow Volume ..... $3.235 \times 10^6 m^3$
Areal Water Load ..... 1.62 m
Retention Coefficient 0.88

WATER QUALITY

Mean Summer Secchi Disc ..... 6.0 m
Chlorophyll a ..... 1.1 µg/L
Total Phosphorus ..... 8 µg/L
Total Nitrogen ..... 243 µg/L
TDS ..... 112 mg/L
Depth of Water Column - Optimal ..... 49 m
- Usable ..... 54 m
Optimal Habitat as a Percentage of Total Lake Volume 58
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 62
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm O_2)
Sensitivity Index 26
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

The 1981 and 1987 surveys of Gould Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season. The lake trout habitat model predicts that Gould Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin.....Native
Lake Trout Potential Annual Yield
.....149 kg or 0.75 kg/ha
Lake Trout Reproduction.....Limited natural reproduction (holding basin)
Stress Factors.....Excessive angler harvest

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1991 (May 19-Sept. 8)	4,352.0	21.9	n/a	

FISHERIES SUMMARY

Natural water level regime.

Gould Lake should be managed as a holding basin for lake trout to provide put and delayed take angling opportunities. In order to protect the native lake trout fishery from overharvest it may be necessary to shorten the open season, reduce the daily catch and possession limits and/or impose bait restrictions.

Future management efforts should include maintaining or enhancing existing habitat, minimizing illegal harvest and establishing a baseline fisheries data series.

Supplemental lake trout plantings may be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from the lake trout population in Gould Lake, a number of other local lakes will be planted with fish species including splake and rainbow trout.

SHORELINE DEVELOPMENT

Residences
- permanent.....2
- seasonal.....24
- total.....26

Private Vacant Lots.....n/a
Tourist Establishments
- number.....–
- rooms/cabins.....–
- campsites.....–

Provincial Park Campsites.....–
% Shoreline Crown.....0
% Shoreline Patent.....100

About half the shoreline is owned by the Cataraqui Region Conservation Authority.

Grimsthorpe Lake

LOCATION

County.....Lennox and Addington
Township.....Grimsthorpe, Anglesea, Effingham
Watershed.....Skootamatta River
Angling Division.....7

MORPHOMETRY

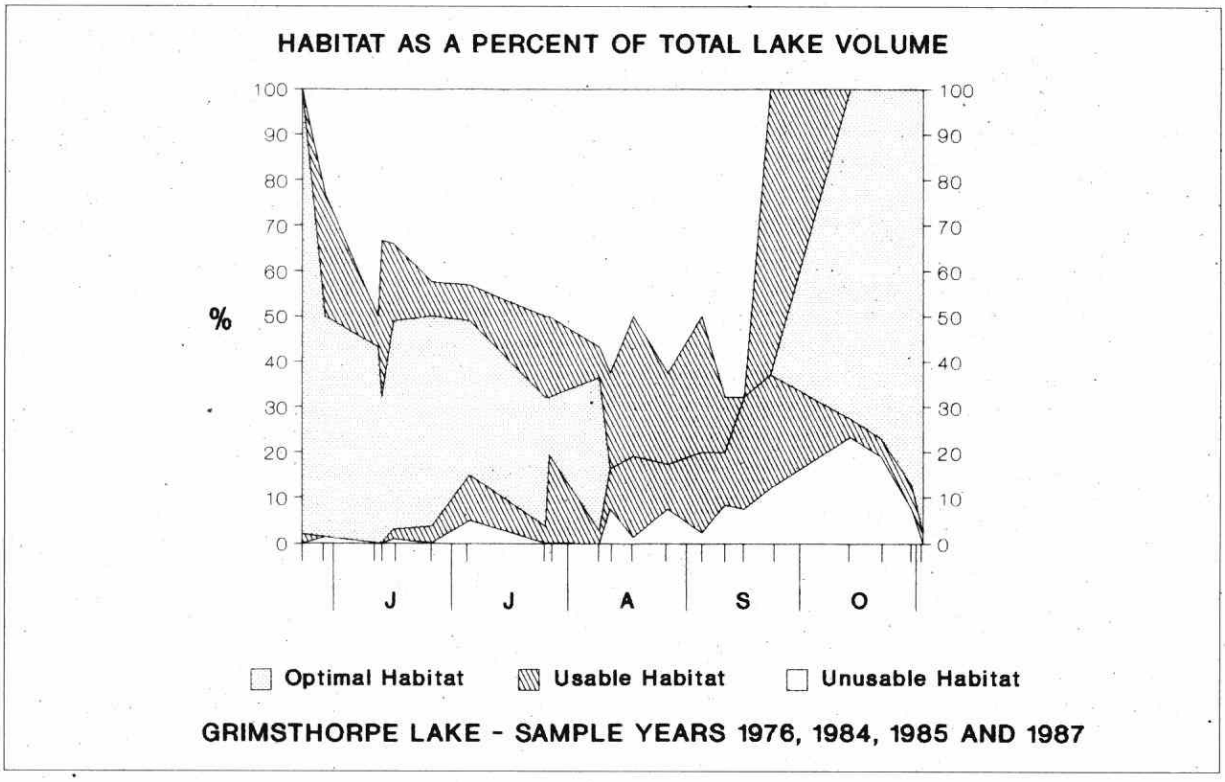
Surface Area.....0.940 x $10^6 m^2$
Epilimnion Volume.....5.168 x $10^6 m^3$
Hypolimnion Volume.....2.174 x $10^6 m^3$
Total Volume.....7.342 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion.....2.377
Maximum Depth.....15.2 m
Mean Depth.....7.7 m

HYDROLOGY

Watershed Area.....84.17 x $10^6 m^2$
Flushing Rate.....4.04 times/year
Outflow Volume.....29.68 x $10^6 m^3$
Areal Water Load.....31.71 m
Retention Coefficient.....0.28

WATER QUALITY

Mean Summer Secchi Disc.....2.5 m
Chlorophyll a.....3.4 µg/L
Total Phosphorus.....12 µg/L
Total Nitrogen.....452 µg/L
TDS.....37.05 mg/L
Depth of Water Column - Optimal.....0 m
- Usable.....14 m
Optimal Habitat as a Percentage of
Total Lake Volume.....0
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume.....42
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index.....100+
Classification.....Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Grimsthorpe Lake reveal poor water quality conditions for lake trout. Average chlorophyll levels are slightly high. Temperature and oxygen profiles show optimal habitat is depleted early in the stratified season.

The lake trout model predicts that Grimsthorpe Lake is highly sensitive to loss of lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin.....Native
(lake trout have never been planted)
Lake Trout Potential Annual Yield
.....65 kg or 0.69 kg/ha
Lake Trout Reproduction.....Limited
natural reproduction
Stress Factors.....Acidic precipitation
(lake is poorly buffered)

FISHERIES SUMMARY

Natural water level regime.

Lake trout fishing pressure is believed to be less than 1,000 man hours (<11 hrs/ha) annually; harvest is unknown.

The lake trout population in Grimsthorpe Lake has declined considerably in recent years but management efforts should be directed at enhancing the resident lake trout population. Future management efforts should involve establishing baseline data from which to manage the fishery, maintaining or enhancing existing fisheries habitat, investigating mitigative techniques for lake acidification and considering regulatory changes to protect resident stocks from overharvest.

SHORELINE DEVELOPMENT

Grimsthorpe Lake is situated within an extensive block of Crown land; there are 2 cottages present.

Hungry Lake

LOCATION

County ..... Frontenac
Township ..... Olden
Watershed ..... Salmon River (Lake Ontario Tributary)
Angling Division 29

MORPHOMETRY

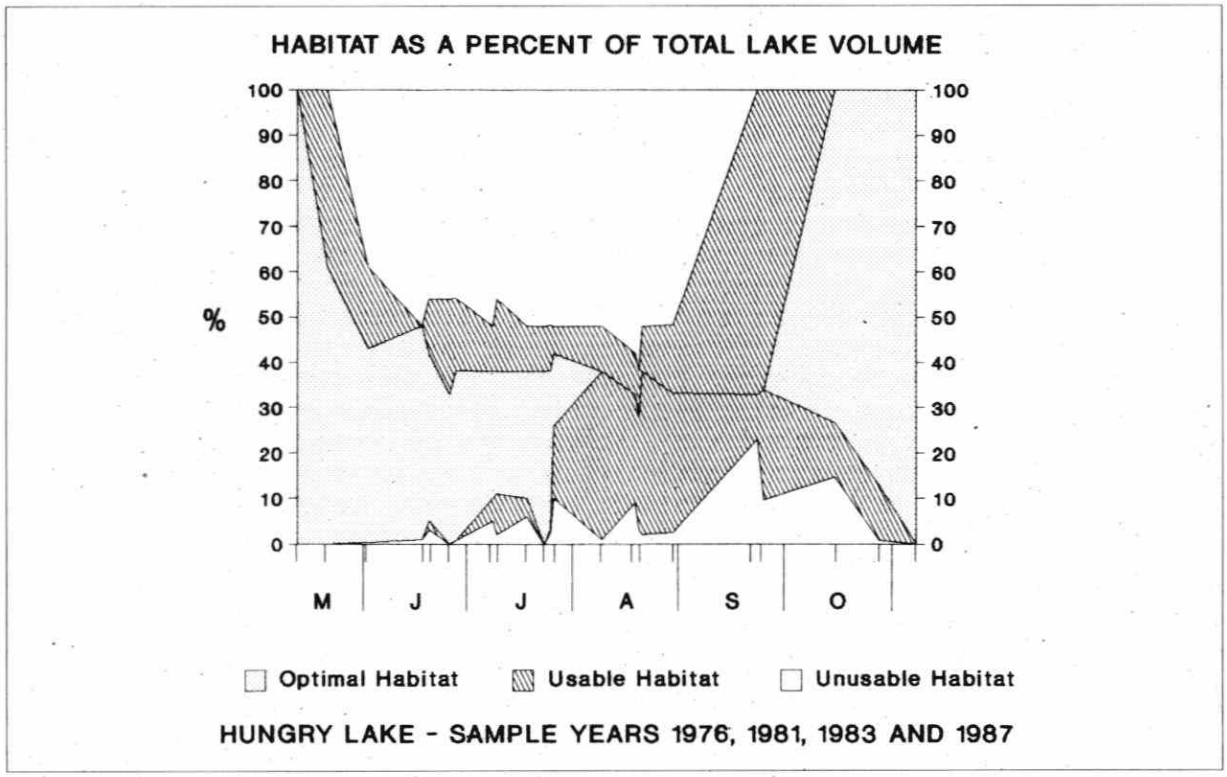
Surface Area ..... 2.550 x $10^6 m^2$
Epilimnion Volume ..... 13.800 x $10^6 m^3$
Hypolimnion Volume ..... 4.740 x $10^6 m^3$
Total Volume ..... 18.540 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 2.911
Maximum Depth ..... 32.0 m
Mean Depth ..... 7.3 m

HYDROLOGY

Watershed Area ..... 69.9 x $10^6 m^2$
Flushing Rate ..... 1.31 times/year
Outflow Volume ..... 24.37 x $10^6 m^3$
Areal Water Load ..... 9.56 m
Retention Coefficient 0.58

WATER QUALITY

Mean Summer Secchi Disc ..... 3.0 m
Chlorophyll a ..... 3.6 µg/L
Total Phosphorus ..... 12.0 µg/L
Total Nitrogen ..... 425 µg/L
TDS ..... 35.10 mg/L
Depth of Water Column - Optimal ..... 0 m
- Usable ..... 8 m
Optimal Habitat as a Percentage of
Total Lake Volume 0
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 26
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Hungry Lake reveal only marginal water quality conditions for lake trout. Average chlorophyll levels are greater than for most of the other lake trout lakes. The temperature and oxygen profiles show optimal habitat is depleted late in the stratified season.

The lake trout habitat model predicts that Hungry Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass, walleye, northern pike
Lake Trout Origin .....Introduced
Lake Trout Potential Annual Yield .....173 kg or 0.68 kg/ha
Lake Trout Reproduction .....No natural reproduction (holding basin)
Stress Factors.....Acidic precipitation (lake is poorly buffered)

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	1,687.6	6.6	49	0.12
1990 (March 10-31)	1,077.7	4.2	81	0.25
1991 (March 9-30)	981.2	3.9	119	0.22
(May 19-Sept. 8)	330.3	1.3	n/a	
1992 (March 14-31)	1,351.3	5.3	n/a	

FISHERIES SUMMARY

Natural water level regime.

Annual lake trout fishing pressure believed to be less than 1,000 man hours (<4 hrs/ha); annual harvest is unknown.

The status of the artificial lake trout fishery in Hungry Lake is believed to be fair but under stress.

Supplemental lake trout stocking will be continued to provide artificial lake trout angling opportunities.

Efforts should be made to protect existing fisheries habitat and examine mitigative techniques for lake acidification.

Programs should be initiated to establish baseline fishing pressure and harvest information.

SHORELINE DEVELOPMENT

Residences
- permanent 1
- seasonal.....7
- total 8

Private Vacant Lots 16
Tourist Establishments
- number 2
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown.....63
% Shoreline Patent.....37

There are two small clusters of cottage development and a year-round lodge at the west end of the lake.

Joeperry Lake

LOCATION

County ..... Lennox and Addington
Township ..... Effingham
Watershed ..... Skootamatta River
Angling Division 29

MORPHOMETRY

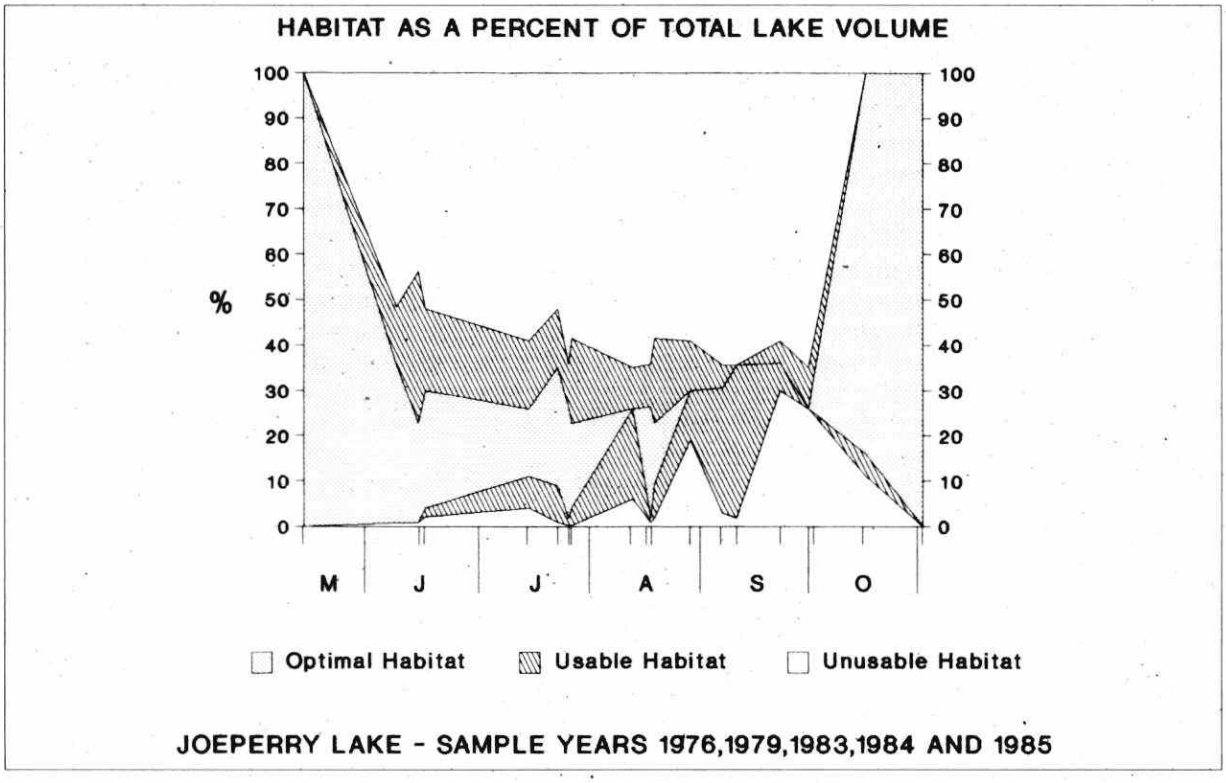
Surface Area ..... $1.690 \times 10^6 m^2$
Epilimnion Volume ..... $9.610 \times 10^6 m^3$
Hypolimnion Volume ..... $2.740 \times 10^6 m^3$
Total Volume ..... $12.350 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 3.507
Maximum Depth ..... 23.0 m
Mean Depth ..... 7.3 m

HYDROLOGY

Watershed Area ..... $15.43 \times 10^6 m^2$
Flushing Rate ..... 0.42 times/year
Outflow Volume ..... $5.19 \times 10^6 m^3$
Areal Water Load ..... 3.07 m
Retention Coefficient 0.80

WATER QUALITY

Mean Summer Secchi Disc ..... 4.6 m
Chlorophyll a ..... 1.7 µg/L
Total Phosphorus ..... 9.0 µg/L
Total Nitrogen ..... 293 µg/L
TDS ..... 25.35 mg/L
Depth of Water Column - Optimal ..... 0 m
- Usable ..... 34 m
Optimal Habitat as a Percentage of Total Lake Volume 0
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 34
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Joeperry Lake reveal only marginal water quality conditions for lake trout. Although average chlorophyll levels are low, temperature and oxygen profiles show optimal habitat is depleted late in the stratified season.

The lake trout habitat model predicts that Joeperry Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass smallmouth bass, northern pike
Lake Trout Origin .....Native (supplemented by some early plantings)
Lake Trout Potential Annual Yield .....98 kg or 0.58 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors .....Acidic precipitation (lake is poorly buffered), marginal water quality in summer

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish*	Kg/Ha
1989 (March 11-31)	53.2	0.32	n/a	
1990 (March 10-31)	0.0	0.0	n/a	
1991 (March 9-30)	0.0	0.0	n/a	
(May 19-Sept. 8)	3,162.0	18.7	n/a	
1992 (March 14-31)	71.7	0.4	n/a	

FISHERIES SUMMARY

Natural water level regime.

Joeperry Lake supports a locally important lake trout fishery which is believed to be in fair condition. Future management efforts should protect the resident lake trout population from overharvest by such means as shorter open seasons, reduced daily catch and possession limits and bait restrictions.

Supplemental plantings of lake trout will continue as required but may be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from the resident lake trout population of Joeperry Lake a number of other local lakes will be planted with species such as splake, rainbow trout and brook trout.

Every effort should be made to protect existing fisheries, habitat, improve water quality and examine mitigative techniques for lake acidification. Programs should be initiated to establish baseline fishing pressure and harvest information.

SHORELINE DEVELOPMENT

Joeperry Lake lies within Bon Echo Provincial Park and is used for canoe-in camping. There are 2 beaches, a dock and about 20 campsites.

Kishkebus Lake

LOCATION

County ..... Frontenac
Township ..... Barrie
Watershed ..... Mississippi River
Angling Division 29

MORPHOMETRY

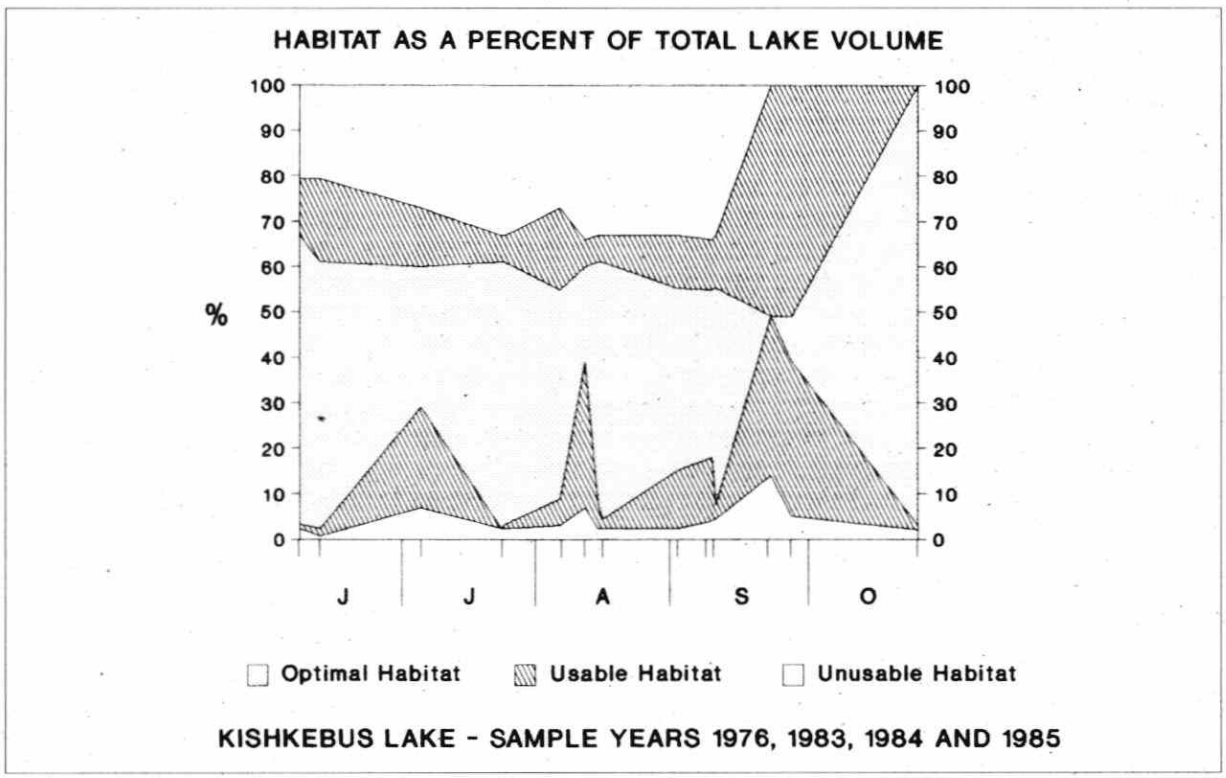
Surface Area ..... 0.850 x $10^6 m^2$
Epilimnion Volume ..... 6.970 x $10^6 m^3$
Hypolimnion Volume ..... 4.460 x $10^6 m^3$
Total Volume ..... 11.430 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.563
Maximum Depth ..... 32.9 m
Mean Depth ..... 13.4 m

HYDROLOGY

Watershed Area ..... 25.37 x $10^6 m^2$
Flushing Rate ..... 0.78 times/year
Outflow Volume ..... 8.95 x $10^6 m^3$
Areal Water Load ..... 10.73 m
Retention Coefficient 0.54

WATER QUALITY

Mean Summer Secchi Disc ..... 4.3 m
Chlorophyll a ..... 2.2 µg/L
Total Phosphorus ..... 8.0 µg/L
Total Nitrogen ..... 338 µg/L
TDS ..... 48.10 mg/L
Depth of Water Column - Optimal ..... 3 m
- Usable ..... 13 m
Optimal Habitat as a Percentage of Total Lake Volume 16
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 57
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm O_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Kishkebus Lake reveal good water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season.

The lake trout habitat model predicts that Kishkebus Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass, largemouth bass
Lake Trout Origin.....Native (supplemented with small irregular plantings)
Lake Trout Potential Annual Yield
.....50 kg or 0.59 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....No major stresses identified

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1981 (March 14-29)	130.0	1.5	n/a	
1989 (March 11-31)	533.4	6.3	n/a	
1990 (March 10-31)	140.7	1.7	n/a	
1991 (March 9-30	266.3	3.1	n/a	
(May 19-Sept. 8)	480.5	5.7	n/a	
1992 (March 14-31)	260.6	3.1	n/a	

FISHERIES SUMMARY

Natural water level regime.

Although relatively little information is available, the lake trout population in Kishkebus Lake is believed to be in relatively good condition. Future management activities should involve efforts to protect and enhance existing fisheries habitat.

Supplemental plantings may continue if required but will be reduced or phased out over the long term. In order to divert fishing pressure away from the resident lake trout population in Kishkebus Lake a number of other local lakes will be planted with species such as splake, rainbow trout and brook trout.

Programs should be implemented to establish baseline fishing pressure and harvest data.

SHORELINE DEVELOPMENT

Kishkebus Lake is situated entirely within Bon Echo Provincial Park and is undeveloped.

Knowlton Lake

LOCATION

County ..... Frontenac
Township ..... Loughborough
Watershed ..... Cataraqui River
Angling Division 9

MORPHOMETRY

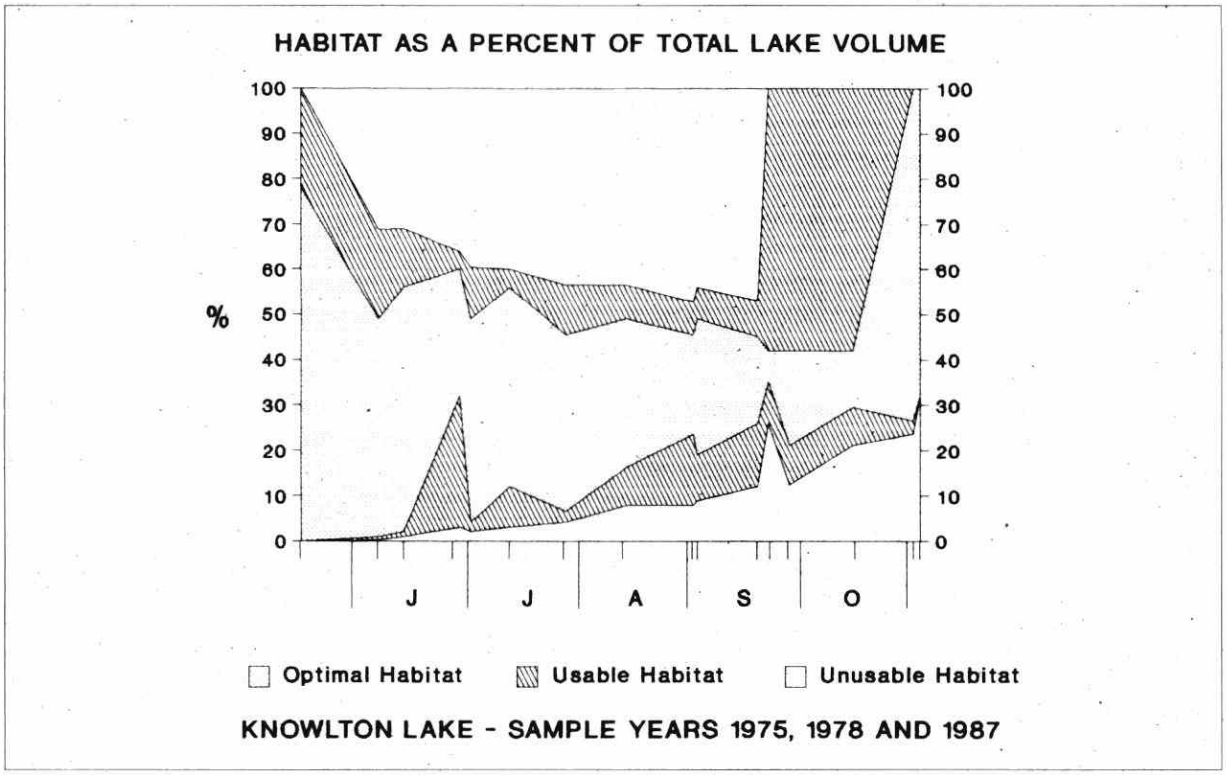
Surface Area ..... 1.820 x $10^6 m^2$
Epilimnion Volume ..... 17.100 x $10^6 m^3$
Hypolimnion Volume ..... 10.730 x $10^6 m^3$
Total Volume ..... 27.830 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.594
Maximum Depth ..... 34.0 m
Mean Depth ..... 15.3 m

HYDROLOGY

Watershed Area ..... 11.10 x $10^6 m^2$
Flushing Rate ..... 0.13 times/year
Outflow Volume ..... 3.64 x $10^6 m^3$
Areal Water Load ..... 2.00 m
Retention Coefficient 0.86

WATER QUALITY

Mean Summer Secchi Disc ..... 5.2 m
Chlorophyll a ..... 1.9 µg/L
Total Phosphorus ..... 14.0 µg/L
Total Nitrogen ..... 408 µg/L
TDS ..... 159.90 mg/L
Depth of Water Column - Optimal ..... 9 m
- Usable ..... 17 m
Optimal Habitat as a Percentage of
Total Lake Volume 23
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of
Total Lake Volume 47
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm O_2)
Sensitivity Index 42
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

Surveys of Knowlton Lake reveal good water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Knowlton Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass, northern pike
Lake Trout Origin .....Native (supplemented by small, irregular plantings)
Lake Trout Potential Annual Yield
.....187 kg or 1.01 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors .....Excessive angler harvest

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1991 (May 19-Sept. 8)	3,638.7	20.0	n/a	

FISHERIES SUMMARY

Natural water level regime.

Winter fishing pressure prior to 1987 approximates 6,000 man hours (32 hrs/ha) with an estimated harvest of 125 trout (130 kg).

The status of the lake trout population in Knowlton Lake is regarded as poor. Future management efforts should include protecting the resident population from overharvest by such means as shorter open seasons, reduced daily catch and possession limits and/or bait restrictions.

Supplemental lake trout plantings will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from resident lake trout stocks in Knowlton Lake, a number of other local lakes will be planted with fish species including splake, brook trout and rainbow trout.

Efforts should be made to protect existing fisheries habitat and rehabilitate degraded habitat. Programs should be implemented to establish or maintain baseline information on fishing pressure and harvest.

SHORELINE DEVELOPMENT

Residences
- permanent 9
- seasonal.....36
- total 45

Private Vacant Lots.....15

Tourist Establishments
- number .....–
- rooms/cabins.....–
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown.....0
% Shoreline Patent.....100

Little Green Lake

LOCATION

County ..... Frontenac
Township ..... Clarendon
Watershed ..... Mississippi River
Angling Division 29

MORPHOMETRY

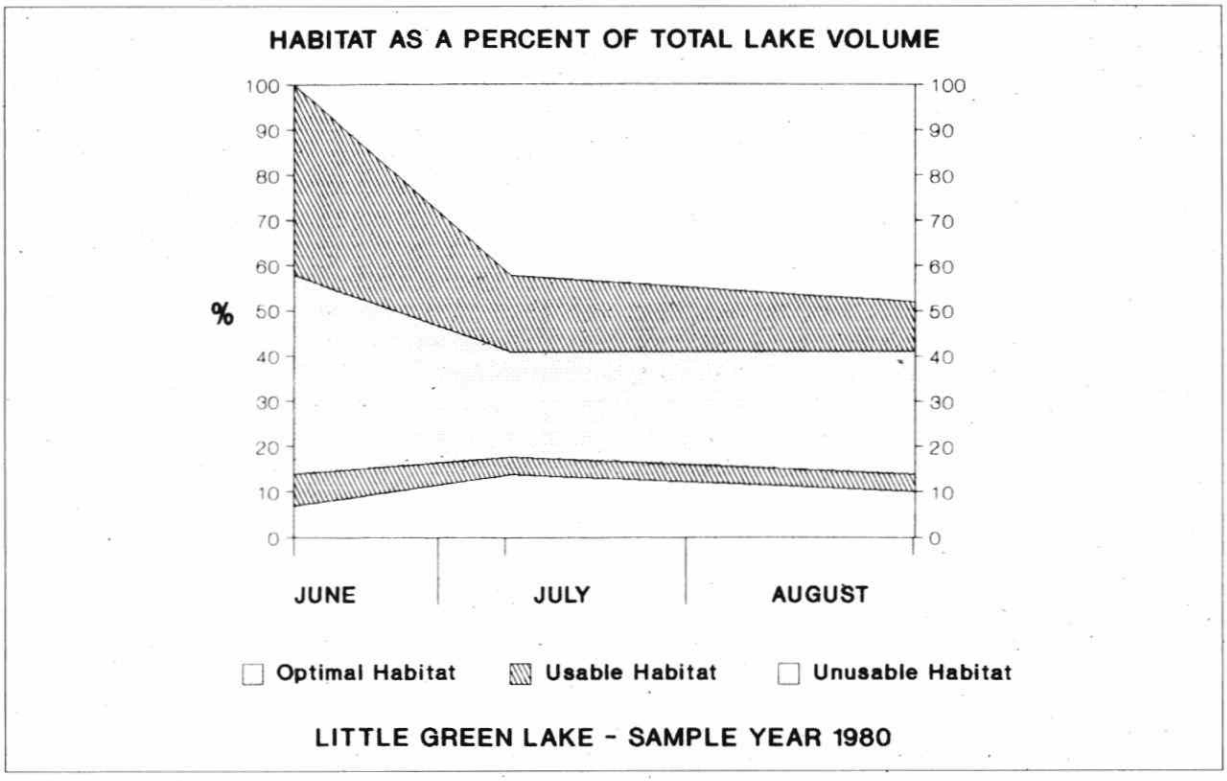
Surface Area ..... $0.290 \times 10^6 m^2$
Epilimnion Volume ..... $2.409 \times 10^6 m^3$
Hypolimnion Volume ..... $1.086 \times 10^6 m^3$
Total Volume ..... $3.495 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 2.218
Maximum Depth ..... 21.0 m
Mean Depth ..... 12.0 m

HYDROLOGY

Watershed Area ..... $3.64 \times 10^6 m^2$
Flushing Rate ..... 0.35 times/year
Outflow Volume ..... $1.239 \times 10^6 m^3$
Areal Water Load ..... 4.25 m
Retention Coefficient 0.74

WATER QUALITY

Mean Summer Secchi Disc ..... 6.7 m
Chlorophyll a ..... 1.7 µg/L
Total Phosphorus ..... 11 µg/L
Total Nitrogen ..... 292 µg/L
TDS ..... 178 mg/L
Depth of Water Column — Optimal ..... 4 m
— Usable ..... 7 m
Optimal Habitat as a Percentage of Total Lake Volume 19
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 34
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1980 survey of Little Green Lake reveals good water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season. The lake trout habitat model predictes that Little Green Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin.....Native (supplemented by some small plantings)
Lake Trout Potential Annual Yield
.....31 kg or 1.06 kg/hr
Lake Trout Reproduction.....Limited natural reproduction
Stress Factors.....None identified

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	52.6	1.8	n/a	
1990 (March 10-31)	23.8	0.8	n/a	
1991 (March 9-30)	47.5	1.6	n/a	
(May 19-Sept. 8)	208.8	7.2	n/a	
1992 (March 14-31)	24.2	0.8	n/a	n/a

FISHERIES SUMMARY

Natural water level regime.

Little Green Lake currently supports a remnant lake trout population which should be managed to maintain or enhance its status. Future management efforts should include phasing out plantings of hatchery reared fish, maintaining or enhancing existing habitat, preventing illegal lake trout harvest and establishing a baseline fisheries data series.

SHORELINE DEVELOPMENT

Residences
- permanent.....–
- seasonal.....7
- total.....7

Private Vacant Lots.....1

Tourist Establishments
- number.....1
- rooms/cabins.....–
- campsites.....10

Provincial Park Campsites.....–
% Shoreline Crown.....35
% Shoreline Patent.....65

Little Mackie (Camp) Lake

LOCATION

County ..... Frontenac
Township ..... Miller
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

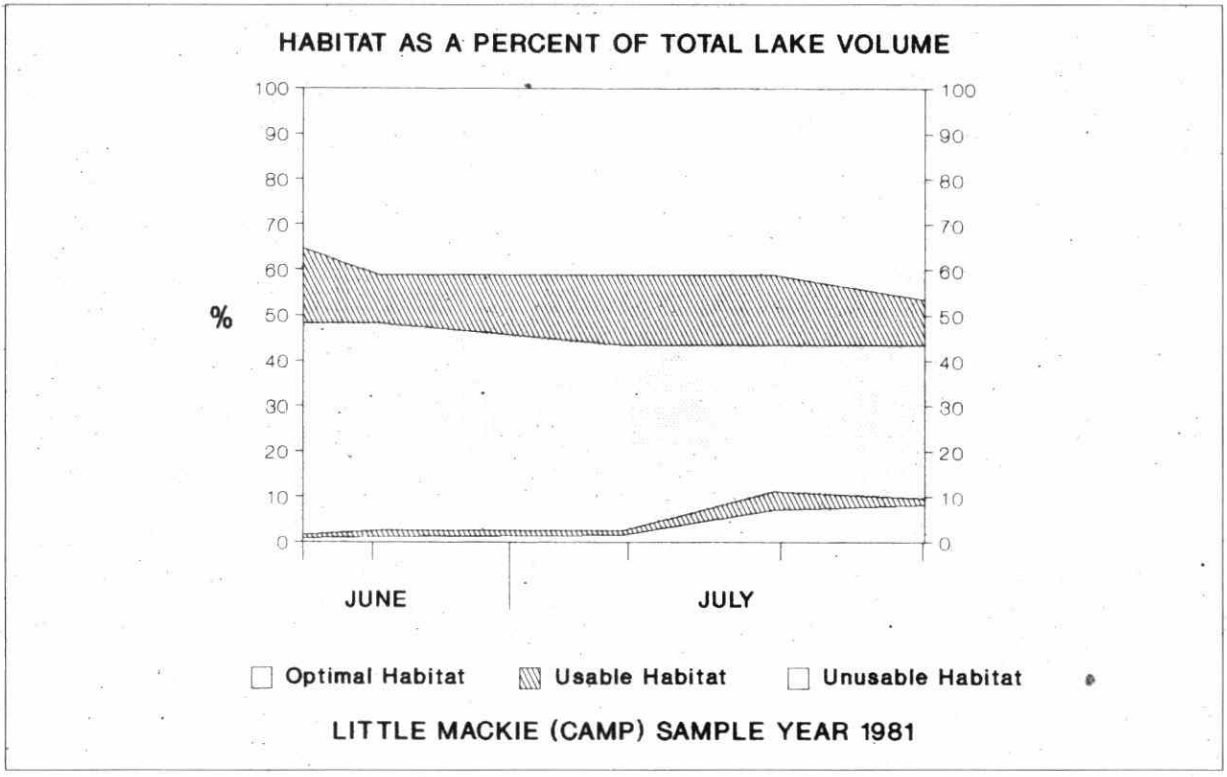
Surface Area ..... 0.530 x $10^6 m^2$
Epilimnion Volume ..... 3.872 x $10^6 m^3$
Hypolimnion Volume ..... 2.470 x $10^6 m^3$
Total Volume ..... 6.342 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.568
Maximum Depth ..... 36.4 m
Mean Depth ..... 11.9 m

HYDROLOGY

Watershed Area ..... 3.676 x $10^6 m^2$
Flushing Rate ..... 0.19 times/year
Outflow Volume ..... 1.21 x $10^6 m^3$
Areal Water Load ..... 2.27 m
Retention Coefficient 0.85

WATER QUALITY

Mean Summer Secchi Disc ..... 7.4 m
Chlorophyll a ..... 1.64 µg/L
Total Phosphorus ..... 8.8 µg/L
Total Nitrogen ..... n/a
TDS ..... n/a
Depth of Water Column — Optimal ..... 10 m
— Usable ..... 13 m
Optimal Habitat as a Percentage of
Total Lake Volume 31
Aug. 31 (≤ 10°C & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of
Total Lake Volume 42
Aug. 31 (≤ 15.5°C & ≥ 4 ppm O_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1981 survey of Little Mackie Lake reveals good water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season. The lake trout habitat model predicts that Little Mackie Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, lake whitefish, smallmouth bass
Lake Trout Origin .....Introduced
Lake Trout Potential Annual Yield .....29 kg or 0.54 kg/ha
Lake Trout Reproduction.....Limited natural reproduction (holding basin)
Stress Factors.....None identified

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	400.2	7.6	n/a	
1990 (March 10-31)	229.5	4.3	55	0.19
1991 (March 9-30)	216.2	4.1	n/a	
(May 19-Sept. 8)	683:2	12.9	n/a	
1992 (March 14-31)	245.2	4.6	n/a	

FISHERIES SUMMARY

Natural water level regime.

Little Mackie Lake presently supports only a remnant lake trout population and should be managed as a holding basin to provide a put and delayed take lake trout fishery. Future management efforts should include maintaining or enhancing existing fisheries habitat, preventing illegal lake trout harvest, planting hatchery reared lake trout and establishing a baseline fisheries data series.

SHORELINE DEVELOPMENT

The lake is surrounded by Crown land; there is one hunt camp.

Long Mallory Lake

LOCATION

County ..... Lennox and Addington
Township ..... Abinger
Watershed ..... Mississippi River
Angling Division 29

MORPHOMETRY

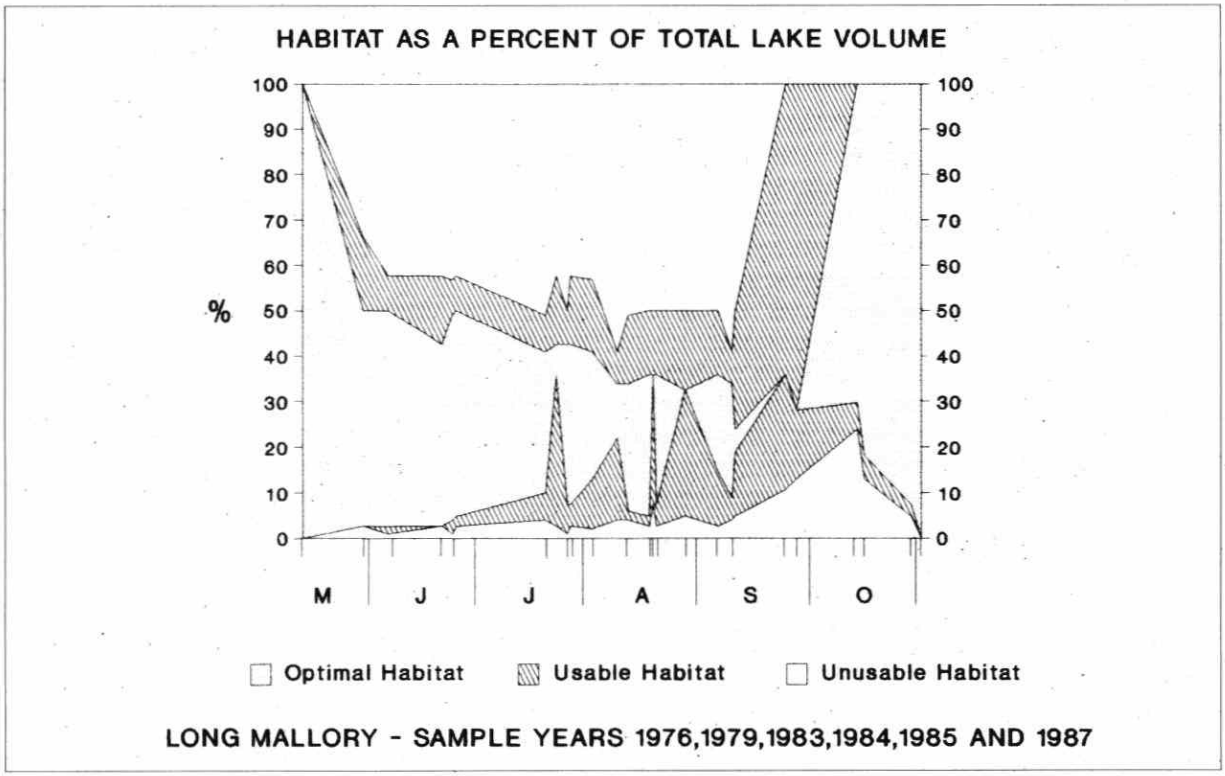
Surface Area ..... $0.630 \times 10^6 m^2$
Epilimnion Volume ..... $3.842 \times 10^6 m^3$
Hypolimnion Volume ..... $1.128 \times 10^6 m^3$
Total Volume ..... $4.970 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 3.406
Maximum Depth ..... 17.4 m
Mean Depth ..... 7.9 m

HYDROLOGY

Watershed Area ..... $9.17 \times 10^6 m^2$
Flushing Rate ..... 0.60 times/year
Outflow Volume ..... $3.00 \times 10^6 m^3$
Areal Water Load ..... 4.76 m
Retention Coefficient 0.72

WATER QUALITY

Mean Summer Secchi Disc ..... 4.6 m
Chlorophyll a ..... 1.3 µg/L
Total Phosphorus ..... 10.0 µg/L
Total Nitrogen ..... 291 µg/L
TDS ..... 22.10 mg/L
Depth of Water Column — Optimal ..... 2 m
— Usable ..... 6 m
Optimal Habitat as a Percentage of
Total Lake Volume 11
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 31
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Long Mallory Lake reveal only marginal water quality conditions for lake trout. Although average chlorophyll levels are low, temperature and oxygen profiles show limited optimal habitat exists late in the stratified season.

The lake trout habitat model predicts that Long Mallory Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass, northern pike

Lake Trout Origin .....Introduced (No recent plantings)

Lake Trout Potential Annual Yield .....33 kg or 0.52 kg/ha

Lake Trout Reproduction.....Limited natural reproduction (holding basin)

Stress Factors.....Acidic precipitation (lake is poorly buffered)

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	0.0	0.0	n/a	
1990 (March 10-31)	0.0	0.0	n/a	
1991 (March 9-30)	77.4	1.2	n/a	
(May 19-Sept. 8)	122.5	1.9	n/a	
1992 (March 14-31)	63.8	1.0	n/a	

FISHERIES SUMMARY

Natural water level regime.

Long Mallory Lake supports a remnant lake trout population. Management programs in the future should include maintaining the existing lake trout stocking program to provide a put and delayed take lake trout fishery. Additional coldwater fishing opportunities in the area will also be provided by splake plantings in Brooks Lake.

Efforts should be made to protect existing fisheries habitat and enhance degraded habitat including examining mitigative techniques for lake acidification.

Enforcement efforts should be directed toward preventing illegal lake trout harvest.

Programs should be implemented to establish baseline information on fishing pressure and harvest.

SHORELINE DEVELOPMENT

The lake is situated within a large block of Crown land. There is one private parcel of 0.53 hectares.

Loughborough Lake (West Basin)

LOCATION

County ..... Frontenac
Township ..... Loughborough, Storrington, Kingston
Watershed ..... Cataraqui River
Angling Division 9

MORPHOMETRY

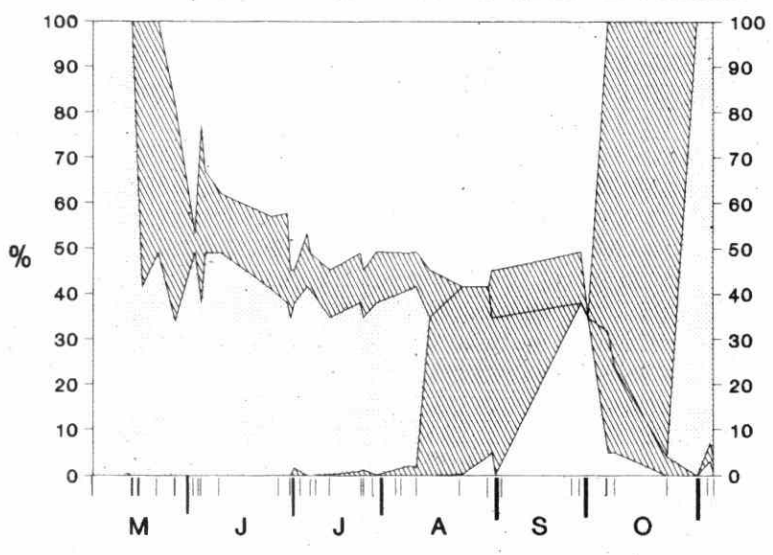
Surface Area ..... $7.380 \times 10^6 m^2$
Epilimnion Volume ..... $71.148 \times 10^6 m^3$
Hypolimnion Volume ..... $37.897 \times 10^6 m^3$
Total Volume ..... $109.045 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.877
Maximum Depth ..... 38.4 m
Mean Depth ..... 14.6 m

HYDROLOGY

Watershed Area ..... $58.22 \times 10^6 m^2$
Flushing Rate ..... 0.18 times/year
Outflow Volume ..... $19.42 \times 10^6 m^3$
Areal Water Load ..... 2.63 m
Retention Coefficient 0.83

WATER QUALITY

Mean Summer Secchi Disc ..... 5.0 m
Chlorophyll a ..... 3.1 µg/L
Total Phosphorus ..... 24 µg/L
Total Nitrogen ..... 412 µg/L
TDS ..... 151.45 mg/L
Depth of Water Column — Optimal ..... 0 m
— Usable ..... 18 m
Optimal Habitat as a Percentage of
Total Lake Volume 0
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of
Total Lake Volume 40
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm O_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



LOUGHBOROUGH LAKE - SAMPLE YEARS 1975, 1981, 1987, 1988 AND 1989

WATER QUALITY SUMMARY

Surveys of Loughborough Lake reveal poor water quality conditions for lake trout. Average chlorophyll levels are usually low. The temperature and oxygen profiles indicate optimal habitat is depleted early in the stratified season.

According to the lake habitat model predictions, Loughborough Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species .....Lake trout, rainbow smelt, largemouth bass, smallmouth bass, northern pike
Lake Trout Origin .....Native (supplemented by small plantings)
Lake Trout Potential Annual Yield .....738 kg or 1.00 kg/ha
Lake Trout Reproduction .....Limited natural reproduction (holding basin)
Stress Factors .....Physical loss of spawning substrate and introduction of undesirable fish species

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1981 (June 6-Aug. 26)	5,750.8	7.8	88	n/a
1991 (June 1-Sept. 8)	60,826.4	82.4	n/a	

FISHERIES SUMMARY

Water levels controlled by Gananoque Light and Power Company.

Lake trout fishing pressure prior to 1987 is estimated at 5,200 angler hours (7 hrs/ha) with a harvest of 605 kg.

The current status of the lake trout population may be regarded as poor. Future management efforts should involve maintaining the lake trout stocking program to rehabilitate the resident population as well as control smelt populations. Alternate coldwater species, such as rainbow trout, may also be planted to provide a more diverse, two tiered fishery. Additional coldwater fishing opportunities will be provided through splake plantings in a number of other local lakes. In order to protect the remnant lake trout population from overharvest it may be necessary to shorten the open season, reduce the daily catch and possession limit and/or impose bait restrictions.

Negotiations should continue with Gananoque Light and Power to ensure water level regimes which are favourable to lake trout spawning, egg incubation and early rearing.

Efforts should be made to protect existing lake trout habitat and rehabilitate degraded habitat, particularly those measures which would improve lake trout recruitment.

Programs should be implemented to establish baseline data on fishing pressure and harvest. In addition an active fisheries extension program should be developed with various user/interest groups on the lake.

SHORELINE DEVELOPMENT

Residences
- permanent 110
- seasonal 233
- total 343

Private Vacant Lots 82

Tourist Establishments
- number 6
- rooms/cabins 35
- campsites 163

Provincial Park Campsites .....–
% Shoreline Crown 0
% Shoreline Patent 100

Loyst Lake

LOCATION

County .....Lennox and Addington
Township .....Sheffield
Watershed ...Salmon River (Lake Ontario Tributaries)
Angling Division 9

MORPHOMETRY

[Incomplete Data]

Surface Area .....0.160 x $10^6 m^2$
Total Volume .....2.274 x $10^6 m^3$
Maximum Depth .....31.0 m
Mean Depth .....14.0 m

WATER QUALITY

[No Data Available]

Classification .....Highly Sensitive *

HYDROLOGY

[No Data Available]

[No Data Available]

WATER QUALITY SUMMARY

* Due to the morphometric characteristics of this headwater lake it has been placed in the Highly Sensitive class. Water quality surveys are required to confirm this classification.

FISHERIES

Major Sport Species.....Lake trout, northern pike, largemouth bass, smallmouth bass, yellow perch
Lake Trout Origin.....Native (+ plantings in 1969)
Lake Trout Potential Annual Yield .....45 kg or 2.75 kg/ha
Lake Trout Reproduction.....Limited natural reproduction (holding basin)
Stress Factors.....Marginal summer water quality

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1991 (June 1-Sept. 8)	53.0	3.3	n/a	

FISHERIES SUMMARY

Natural water level regime.

Loyst Lake contains only a marginal lake trout population and should be managed as a lake trout holding basin to provide put and delayed take angling opportunities. This will involve regular plantings of hatchery reared lake trout.

Efforts should be made to protect and enhance existing fisheries habitat, prevent illegal lake trout harvest and implement programs to establish baseline fishing pressure and harvest information.

SHORELINE DEVELOPMENT

The lake is surrounded by Crown land.

Lucky Lake

LOCATION

County ..... Frontenac
Township ..... Miller
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

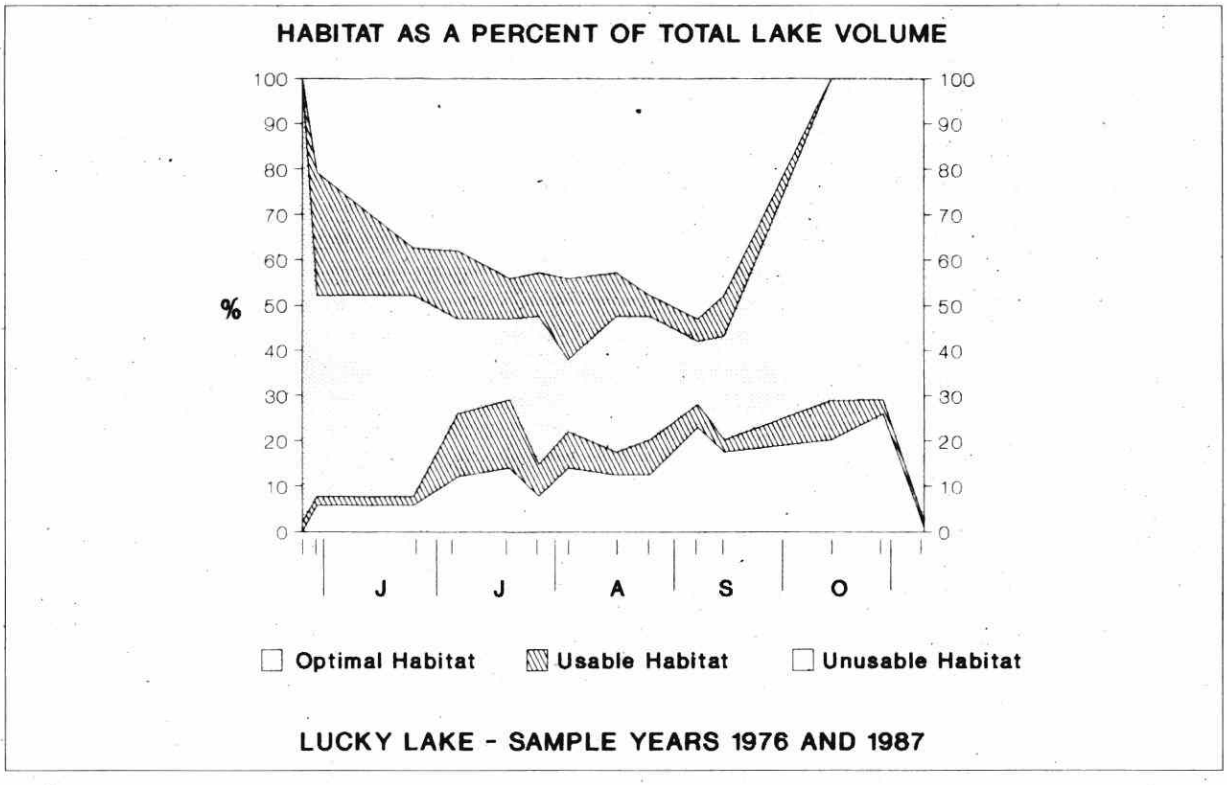
Surface Area ..... 1.000 x $10^6 m^2$
Epilimnion Volume ..... 7.700 x $10^6 m^3$
Hypolimnion Volume ..... 4.120 x $10^6 m^3$
Total Volume ..... 11.820 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.869
Maximum Depth ..... 27.7 m
Mean Depth ..... 11.8 m

HYDROLOGY

Watershed Area ..... 8.39 x $10^6 m^2$
Flushing Rate ..... 0.26 times/year
Outflow Volume ..... 0.92 x $10^6 m^3$
Areal Water Load ..... 2.73 m
Retention Coefficient 0.82

WATER QUALITY

Mean Summer Secchi Disc ..... 7.6 m
Chlorophyll a ..... 2.2 µg/L
Total Phosphorus ..... 15.0 µg/L
Total Nitrogen ..... 283 µg/L
TDS ..... 66.95 mg/L
Depth of Water Column — Optimal ..... 2 m
— Usable ..... 8 m
Optimal Habitat as a Percentage of Total Lake Volume 14
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 29
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1976 and 1987 surveys of Lucky Lake reveal good water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season.

The lake trout habitat model predicts that Lucky Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass
Lake Trout Origin .....Native (supplemented by some small plantings)

Lake Trout Potential Annual Yield .....74 kg or 0.74 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors .....Excessive angler harvest

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1979 (March 10-31)	2,077.0	20.8	79	0.59
1981 (March 14-29)	813.9	8.1	na/	
1989 (March 11-31)	369.4	3.7	55	0.63
1990 (March 10-31)	811.5	8.1	32	0.10
1991 (March 9-31)	2,313.4	23.1	340	1.60
(May 19-Sept. 8)	1,110.2	11.1	n/a	
1992 (March 14-31)	1,601.7	16.0	n/a	

FISHERIES SUMMARY

Natural water level regime.

The lake trout population in Lucky Lake is believed to be in reasonably good condition. Future management efforts should maintain and actively enforce existing regulations in order to prevent overharvest.

Supplemental lake trout plantings will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from the resident lake trout population in Lucky Lake, other local lakes will be planted with fish species including splake, rainbow trout and brook trout.

Efforts should also be made to protect existing fisheries habitat and to implement programs to establish baseline information on fishing pressure and harvest.

SHORELINE DEVELOPMENT

Residences
- permanent .....–
- seasonal 1
- total 1

Private Vacant Lots .....–

Tourist Establishments
- number 1
- rooms/cabins 4
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown .....>99
% Shoreline Patent .....<1

Mackie Lake

LOCATION

County ..... Frontenac
Township ..... Miller
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

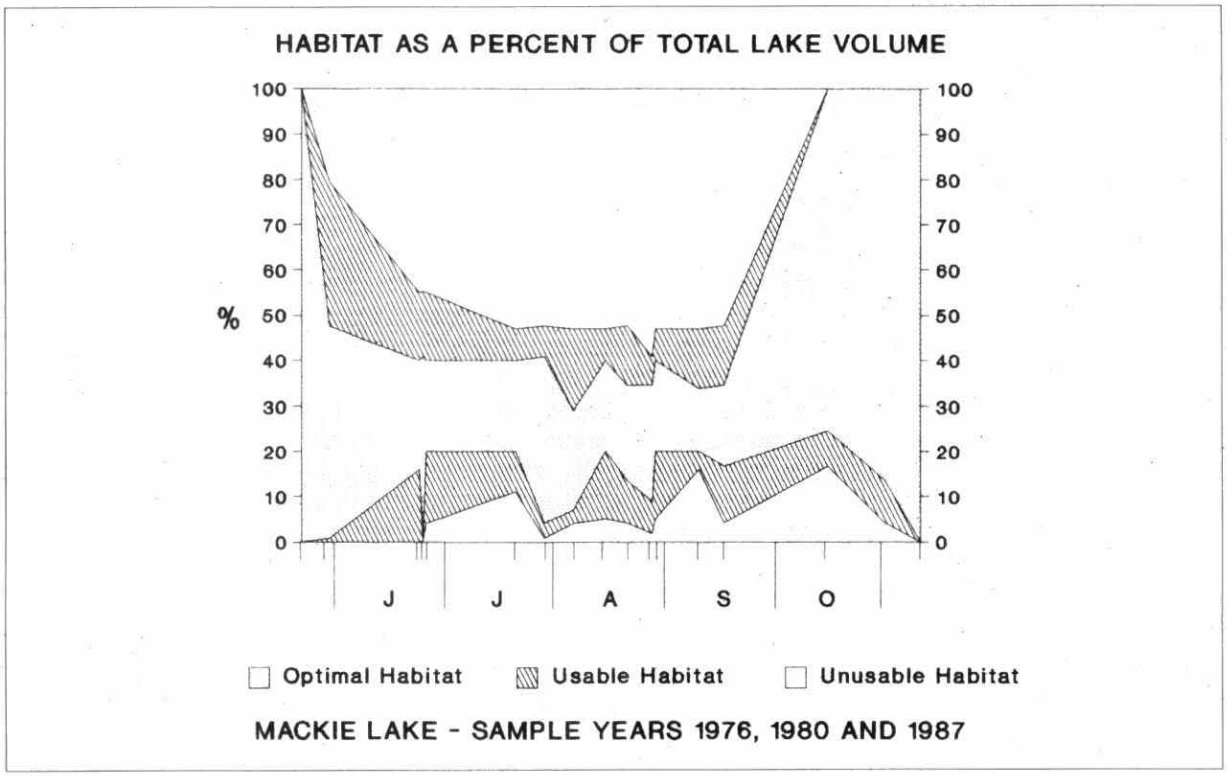
Surface Area ..... $1.580 \times 10^6 m^2$
Epilimnion Volume ..... $11.021 \times 10^6 m^3$
Hypolimnion Volume ..... $2.719 \times 10^6 m^3$
Total Volume ..... $13.740 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 4.052
Maximum Depth ..... 23.0 m
Mean Depth ..... 8.7 m

HYDROLOGY

Watershed Area ..... $40.52 \times 10^6 m^2$
Flushing Rate ..... 1.01 times/year
Outflow Volume ..... $13.92 \times 10^6 m^3$
Areal Water Load ..... 8.81 m
Retention Coefficient 0.59

WATER QUALITY

Mean Summer Secchi Disc ..... 5.8 m
Chlorophyll a ..... 2.4 µg/L
Total Phosphorus ..... 11.0 µg/L
Total Nitrogen ..... 304 µg/L
TDS ..... 59.80 mg/L
Depth of Water Column — Optimal ..... 1 m
— Usable ..... 7 m
Optimal Habitat as a Percentage of Total Lake Volume 5
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 34
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1976, 1980 and 1987 surveys of Mackie Lake reveal only marginal water quality conditions for lake trout. Although average chlorophyll levels are low, temperature and oxygen profiles show limited optimal habitat exists late in the stratified season.

The lake trout habitat model predicts that Mackie Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species .....Lake trout, largemouth bass, smallmouth bass, northern pike
Lake Trout Origin.....Native (supplemented by a number of small plantings)
Lake Trout Potential Annual Yield .....101 kg or 0.64 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Physical degradation and loss of spawning beds

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1979 (March 10-31)	2,256.0	14.3	n/a	
1989 (March 11-31)	415.3	2.6	39	0.16
1990 (March 10-31)	96.0	0.6	n/a	
1991 (March 9-31)	130.5	0.8	n/a	
(May 19-Sept. 8)	240.2	1.5	n/a	
1992 (March 14-31)	311.9	2.0	n/a	

FISHERIES SUMMARY

Natural water level regime.

The present status of the lake trout population in Mackie Lake is believed to be fair. Future management efforts should include protecting existing fisheries habitat and enhancing degraded habitat, particularly spawning shoals.

Supplemental lake trout stocking will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure from resident lake trout stocks in Mackie Lake, a number of other local lakes will be planted with fish species including splake, rainbow trout and brook trout.

Enforcement efforts should be directed to preventing illegal lake trout harvest. Programs should be implemented to establish baseline information on fishing pressure and harvest.

SHORELINE DEVELOPMENT

Residences
- permanent 1
- seasonal.....41
- total 42

Private Vacant Lots.....1

Tourist Establishments
- number 2
- rooms/cabins 37
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown.....68
% Shoreline Patent.....32

Mazinaw Lake

LOCATION

County .....Frontenac, Lennox and Addington
Township .....Abinger, Barrie
Watershed .....Mississippi River
Angling Division 29

MORPHOMETRY

Surface Area .....15.900 x $10^6 m^2$
Epilimnion Volume .....141.300 x $10^6 m^3$
Hypolimnion Volume .....543.600 x $10^6 m^3$
Total Volume .....684.900 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 0.260
Maximum Depth .....144.8 m
Mean Depth .....43.1 m

HYDROLOGY

Watershed Area .....326.00 x $10^6 m^2$
Flushing Rate .....0.17 times/year
Outflow Volume .....114.88 x $10^6 m^3$
Areal Water Load .....6.98 m
Retention Coefficient 0.64

WATER QUALITY

Mean Summer Secchi Disc .....5.2 m
Chlorophyll a .....1.2 µg/L
Total Phosphorus .....9.0 µg/L
Total Nitrogen .....270 µg/L
TDS .....37.05 mg/L
Depth of Water Column — Optimal .....108 m
— Usable .....120 m
Optimal Habitat as a Percentage of
Total Lake Volume 79
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 86
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index 1
Classification .....Moderately Sensitive

[No Data Available]

WATER QUALITY SUMMARY

The 1971 survey of Mazinaw Lake reveals excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season. Due to the lake's extremely large size and other morphometric characteristics it is classified as Moderately Sensitive.

According to the lake trout habitat model predictions, Mazinaw Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, walleye, largemouth bass, smallmouth bass
Lake Trout Origin.....Native (supplemented by some small plantings)
Lake Trout Potential Annual Yield .....461 kg or 0.29 kg/ha
Lake Trout Reproduction.....Limited natural reproduction
Stress Factors.....Adverse water level fluctuations

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	604.0	0.4	151	0.21
1990 (March 10-30)	315.3	0.2	24	0.03
1991 (March 9-30)	1,019.2	0.6	n/a	
(May 19-Sept. 8)	6,373.1	4.0	n/a	
1992 (March 14-31)	1,084.2	0.7	n/a	

FISHERIES SUMMARY

Water level controlled by Mississippi Valley Conservation Authority for power generation by Ontario Hydro.

The lake trout population in Mazinaw Lake has declined to the point where it is now considered to be in fair condition. Future efforts will be directed at enhancing resident lake trout stocks.

Negotiations should continue with Ontario Hydro to ensure water level regimes which are favourable to lake trout spawning, egg incubation and early rearing.

Efforts should be made to protect existing habitat and enhance degraded fisheries habitat. Enforcement activities should be directed at preventing illegal harvest. Programs should be implemented to establish baseline information on fishing pressure and harvest.

SHORELINE DEVELOPMENT

Currently accurate shoreline development information is not available.

Part of the lake is within the boundary of Bon Echo Provincial Park.

Mosque Lake

LOCATION

County ..... Frontenac
Township ..... Clarendon, Miller, South Canonto
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

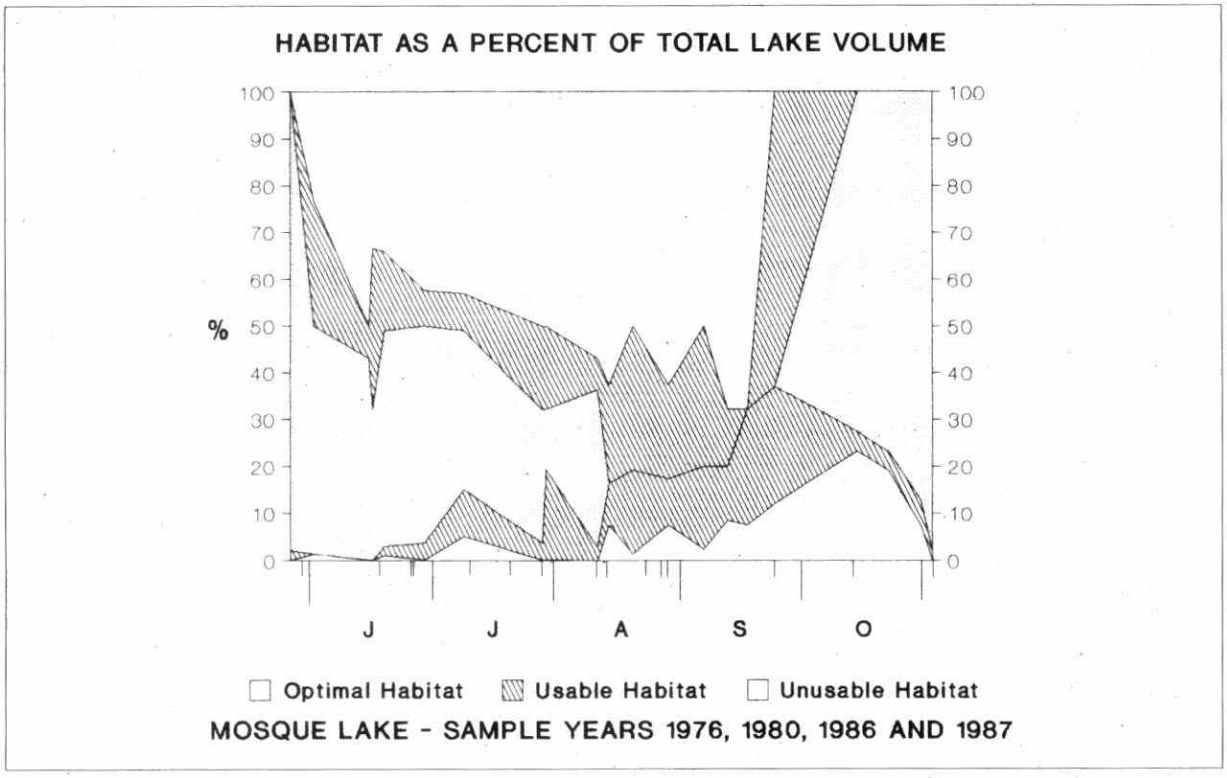
Surface Area ..... 1.380 x $10^6 m^2$
Epilimnion Volume ..... 8.226 x $10^6 m^3$
Hypolimnion Volume ..... 1.978 x $10^6 m^3$
Total Volume ..... 10.204 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 4.159
Maximum Depth ..... 34.0 m
Mean Depth ..... 7.4 m

HYDROLOGY

Watershed Area ..... 6.21 x $10^6 m^2$
Flushing Rate ..... 0.19 times/year
Outflow Volume ..... 1.96 x $10^6 m^3$
Areal Water Load ..... 1.41 m
Retention Coefficient 0.90

WATER QUALITY

Mean Summer Secchi Disc ..... 6.1 m
Chlorophyll a ..... 1.9 µg/L
Total Phosphorus ..... 18.0 µg/L
Total Nitrogen ..... 352 µg/L
TDS ..... 56.55 mg/L
Depth of Water Column — Optimal ..... 0 m
— Usable ..... 3 m
Optimal Habitat as a Percentage of Total Lake Volume 0
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 12
Aug. 31 ($\leq 15.5°C$ & $\geq$ 4 ppm O_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Mosque Lake reveal only marginal water quality conditions for lake trout. Although average chlorophyll levels are low, temperature and oxygen profiles show optimal habitat exists late in the stratified season.

The lake trout habitat model predicts that Mosque Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, rainbow trout (planted)
Lake Trout Origin .....Native (supplemented by several small plantings)
Lake Trout Potential Annual Yield .....120 kg or 0.87 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors.....Excessive angler harvest (historical) and inadequate summer oxygen/temperatures

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	236.8	1.7	n/a	
1990 (March 10-31)	165.9	1.2	0.0	n/a
1991 (March 9-30)	133.8	1.0	n/a	
(May 19-Sept. 8)	276.3	2.0	n/a	
1992 (March 14-31)	136.2	1.0	n/a	

FISHERIES SUMMARY

Water levels regulated by Ministry of Natural Resources dam.

Lake trout in Mosque Lake should be managed to sustain the resident population by implementing such measures as planting rainbow trout (but not lake trout) to provide artificial angling opportunities. In addition, a number of other local lakes will be planted with splake, rainbow trout and brook trout.

Efforts should be made to maintain or enhance existing fisheries habitat including adherence to the existing water level rule curve. Enforcement activities should be directed at preventing illegal harvest of lake trout.

Programs should be implemented to establish baseline information on fishing pressure and harvest.

SHORELINE DEVELOPMENT

Residences
- permanent .....–
- seasonal.....43
- total.....43

Private Vacant Lots.....3

Tourist Establishments
- number .....–
- rooms/cabins .....–
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown.....73
% Shoreline Patent.....27

Murray

LOCATION

County ..... Lanark
Township ..... Darling
Watershed ..... Mississippi River
Angling Division 10

MORPHOMETRY

[Incomplete Data]

Surface Area ..... $0.180 \times 10^6 m^2$
Total Volume ..... $2.286 \times 10^6 m^3$
Maximum Depth ..... 27.5 m
Mean Depth ..... 12.7 m

WATER QUALITY

[Incomplete Data]

TDS ..... 166.5 mg/L

Classification ..... Highly Sensitive *

HYDROLOGY

[No Data Available]

[No Data Available]

WATER QUALITY SUMMARY

* Due to the morphometric characteristics of Murray Lake it has been placed in the Highly Sensitive class. Water quality surveys are required to confirm this classification.

FISHERIES

Major Sport Species .....Lake trout, yellow perch, white sucker, rainbow trout
Lake Trout Origin .....Introduced
Lake Trout Potential Annual Yield .....19.6 kg or 1.11 kg/ha
Lake Trout Reproduction.....Very limited (holding basin)
Stress Factors.....Lack of spawning substrate, limited habitat due to small size of lake

FISHERIES SUMMARY

A landowner presently stocks the lake with rainbow trout. There is little if any current information on angling pressure and harvest. Due to its restricted access the fishery is not believed to be overharvested. Future management activities should involve protecting the existing fisheries habitat and water quality. This would include regulating shoreline and backshore development activities.

Assessment programs should be implemented to investigate spawning activity as well as determine the current status of the resident lake trout population. Efforts should also be directed to establishing information on angling pressure and harvests from this small lake trout fishery.

The lake should continue to be managed as a high quality holding basin until more detailed information is available.

SHORELINE DEVELOPMENT

Murray Lake is surrounded by private land with no public access.

Otter (Cotter) Lake

LOCATION

County ..... Lennox and Addington
Township ..... Ashby
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

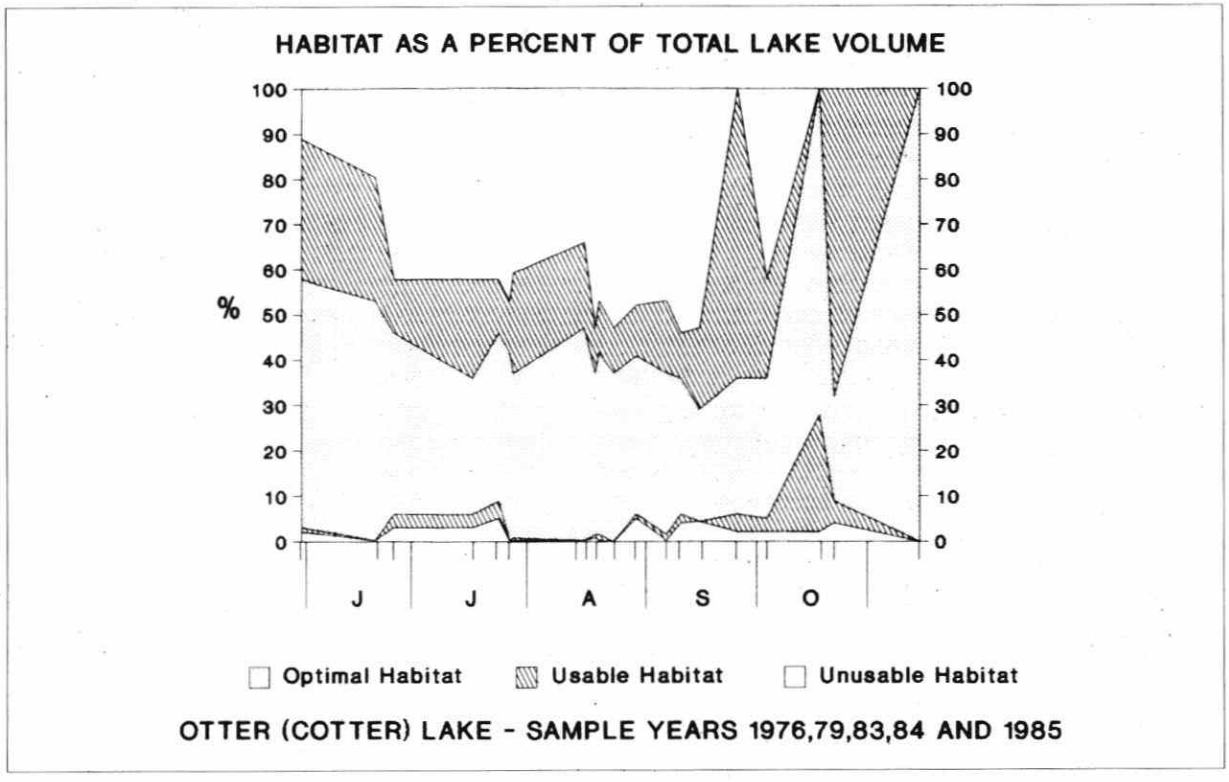
Surface Area ..... $3.060 \times 10^6 m^2$
Epilimnion Volume ..... $18.870 \times 10^6 m^3$
Hypolimnion Volume ..... $7.440 \times 10^6 m^3$
Total Volume ..... $26.310 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 2.536
Maximum Depth ..... 29.3 m
Mean Depth ..... 8.6 m

HYDROLOGY

Watershed Area ..... $73.6 \times 10^6 m^2$
Flushing Rate ..... 0.95 times/year
Outflow Volume ..... $25.25 \times 10^6 m^3$
Areal Water Load ..... 8.25 m
Retention Coefficient 0.60

WATER QUALITY

Mean Summer Secchi Disc ..... 5.2 m
Chlorophyll a ..... 1.5 µg/L
Total Phosphorus ..... 20.0 µg/L
Total Nitrogen ..... 312 µg/L
TDS ..... 32.50 mg/L
Depth of Water Column — Optimal ..... 13 m
— Usable ..... 24 m
Optimal Habitat as a Percentage of
Total Lake Volume 31
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 58
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index 30
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

Surveys of Otter Lake reveal good water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season. The lake trout habitat model predicts that Otter Lake is moderately sensitive to the loss of the remaining optimal lake trout habitat as result of additional nutrient loadings.

FISHERIES

Major Sport Species .....Lake trout, largemouth bass, smallmouth bass, northern pike
Lake Trout Origin.....Native (some plantings)
Lake Trout Potential Annual Yield
.....187 kg or 0.61 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors .....Excessive angler harvest (historical)

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1990 (March 10-31)	25.2	0.1	n/a	
1991 (March 9-30)	0.0	0.0	n/a	
(May 19-Sept. 8)	1,485.2	6.5	n/a	
1992 (March 14-31)	26.0	0.1	n/a	

FISHERIES SUMMARY

Water levels controlled by Ministry of Natural Resources dam.

Otter Lake should be managed to maintain or enhance the resident lake trout population by reducing angler harvest, adhering to the existing water level rule curve, directing enforcement efforts to preventing illegal lake trout harvest and protecting existing fisheries habitat.

Supplemental lake trout plantings will continue but may be reduced or phased out over the long term. In an effort to provide alternate fisheries and divert fishing pressure away from the Otter Lake lake trout fishery, other local lakes will be planted with species including splake, rainbow trout and brook trout.

SHORELINE DEVELOPMENT

Residences
- permanent .....–
- seasonal.....21
- total 21

Private Vacant Lots.....3

Tourist Establishments
- number .....–
- rooms/cabins.....–
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown.....83
% Shoreline Patent.....17

Palmerston Lake

LOCATION

County ..... Frontenac
Township ..... Palmerston, South Canonto
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

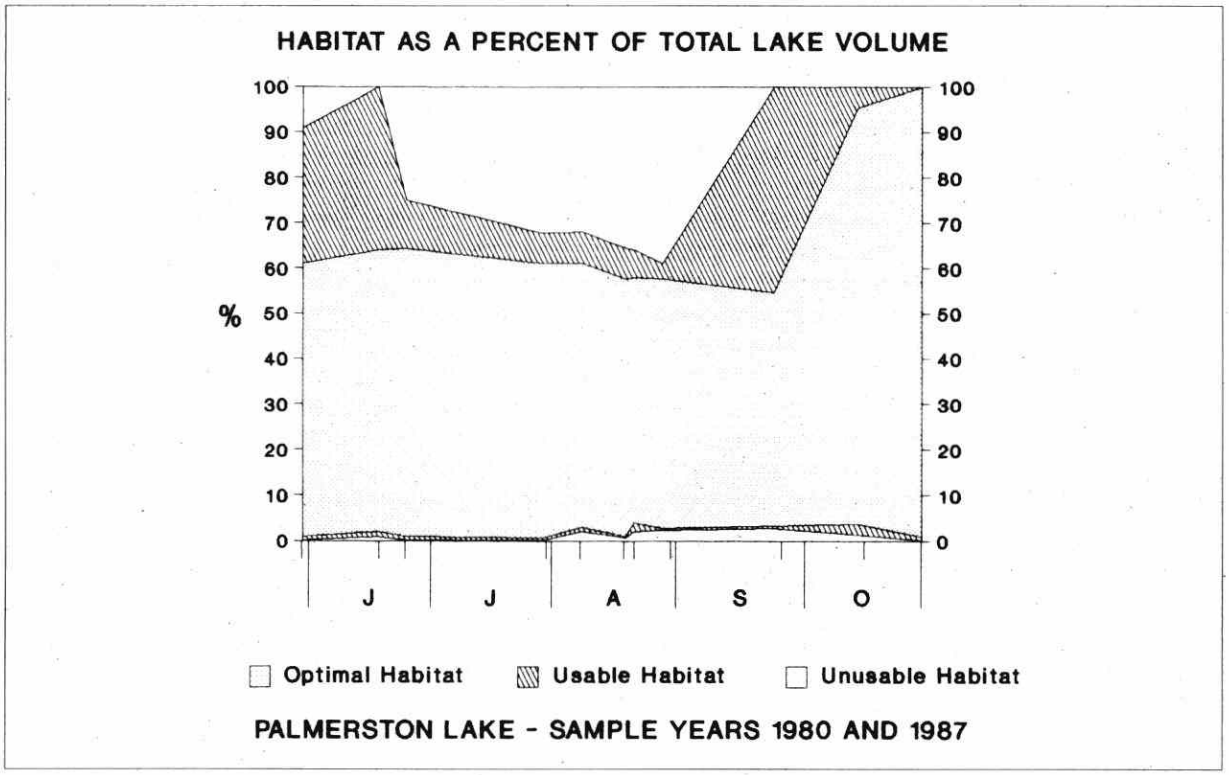
Surface Area ..... 5.630 x $10^6 m^2$
Epilimnion Volume ..... 52.740 x $10^6 m^3$
Hypolimnion Volume ..... 63.160 x $10^6 m^3$
Total Volume ..... 115.900 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 0.835
Maximum Depth ..... 56.0 m
Mean Depth ..... 20.6 m

HYDROLOGY

Watershed Area ..... 46.69 x $10^6 m^2$
Flushing Rate ..... 0.13 times/year
Outflow Volume ..... 15.18 x $10^6 m^3$
Areal Water Load ..... 2.70 m
Retention Coefficient 0.82

WATER QUALITY

Mean Summer Secchi Disc ..... 7.9 m
Chlorophyll a ..... 1.4 µg/L
Total Phosphorus ..... 4 µg/L
Total Nitrogen ..... 230 µg/L
TDS ..... 83.85 mg/L
Depth of Water Column — Optimal ..... 32 m
— Usable ..... 39 m
Optimal Habitat as a Percentage of Total Lake Volume 53
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 62
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index 10
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

The 1980 and 1987 surveys of Palmerston Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Palmerston Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin.....Native
(Supplemented by regular plantings)

Lake Trout Potential Annual Yield
.....355 kg or 0.63 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Excessive angler harvest and degradation of spawning beds

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1976	2,477.3	4.4	n/a	
1979	9,799.0	17.4	n/a	
1981	546.0	1.0	n/a	
1982	2,010.0	3.6	157	n/a
1984 (March 10-31)	5,071.3	9.0	271	n/a
1987 (March 14-31)	4,508.0	8.0	132	n/a
1989 (March 11-31)	2,469.8	4.4	183	0.08
1990 (March 10-31)	2,024.4	3.6	83	0.09
1991 (March 9-31)	6,757.0	12.0	588	0.49
(May 19-Sept. 8)	10,127.1	18.0	n/a	
1992 (March 14-31)	4,642.8	8.2	n/a	

FISHERIES SUMMARY

Water levels controlled by Ministry of Natural Resources dam.

The lake trout population in Palmerston Lake is believed to be in reasonably good condition despite being heavily exploited. Future management efforts should be directed at maintaining the resident lake trout population by adhering to existing water level rule curves, reducing angler harvest and preventing illegal lake trout harvest.

Supplemental lake trout stocking will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from the lake trout fishery in Palmerston Lake, a number of other local lakes will be planted with fish species including splake, rainbow trout and brook trout.

Efforts should be directed to establishing a program to monitor angling pressure and harvests on this heavily utilized fishery.

SHORELINE DEVELOPMENT

Residences
- permanent 11
- seasonal 92
- total 103

Private Vacant Lots 50
Tourist Establishments
- number 3
- rooms/cabins 26
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown 15
% Shoreline Patent 85

There is Crown land along the northwest shore and Mississippi Valley Conservation Authority property at the east end. Development is located mainly along the south shore on large lots. The lake is easily accessed by Highway 509.

Potspoon Lake

LOCATION

County ..... Frontenac
Township ..... Bedford
Watershed ..... Napanee River (Western St. Lawrence Tributaries)
Angling Division 9

MORPHOMETRY

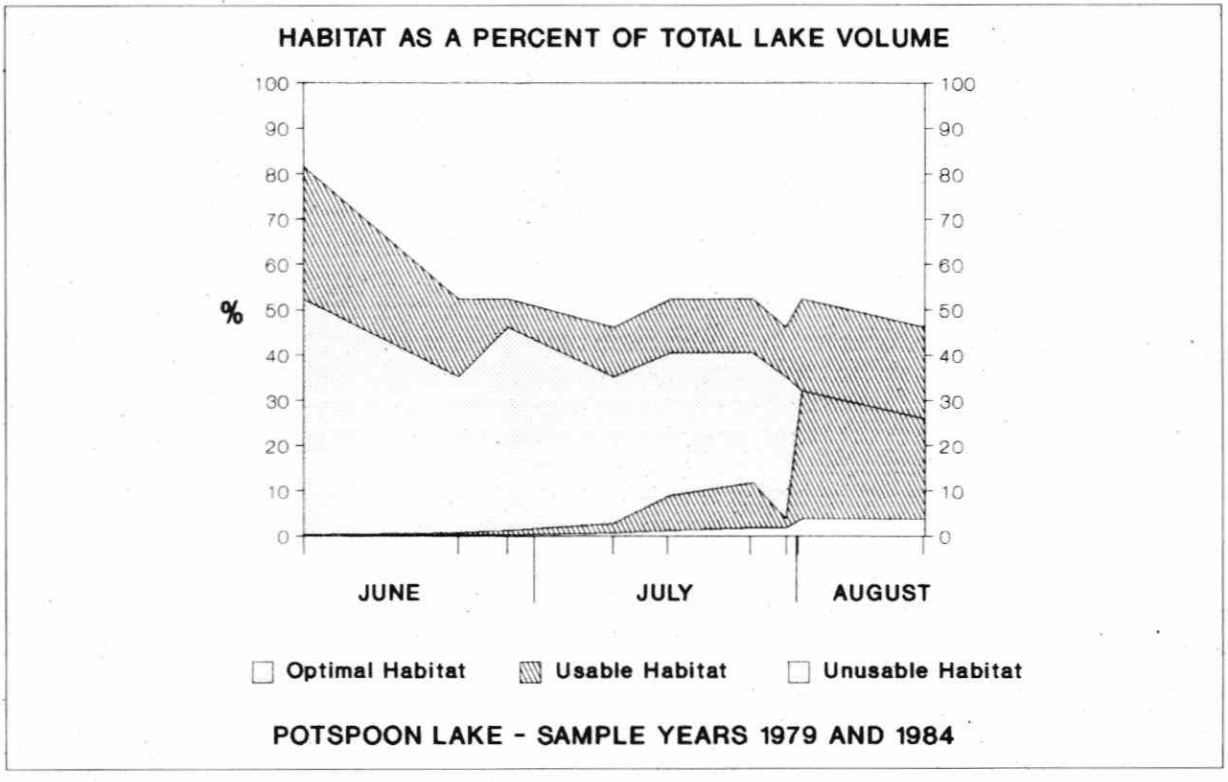
Surface Area ..... 0.790 x $10^6 m^2$
Epilimnion Volume ..... 5.084 x $10^6 m^3$
Hypolimnion Volume ..... 2.213 x $10^6 m^3$
Total Volume ..... 7.297 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 2.297
Maximum Depth ..... 27.0 m
Mean Depth ..... 9.3 m

HYDROLOGY

Watershed Area ..... 8.00 x $10^6 m^2$
Flushing Rate ..... 0.37 times/year
Outflow Volume ..... 2.684 x $10^6 m^3$
Areal Water Load ..... 3.41 m
Retention Coefficient 0.79

WATER QUALITY

Mean Summer Secchi Disc ..... 3.5 m
Chlorophyll a ..... 1.6 µg/L
Total Phosphorus ..... 11.0 µg/L
Total Nitrogen ..... 304 µg/L
TDS ..... 102 mg/L
Depth of Water Column — Optimal ..... 0 m
— Usable ..... 9 m
Optimal Habitat as a Percentage of Total Lake Volume 0
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 37
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1979 and 1984 surveys of Potspoon Lake reveal poor water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is depleted early in the stratified season. The lake trout habitat model predicts that Potspoon Lake is highly sensitive to loss of the remaining lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, northern pike, smallmouth bass, largemouth bass
Lake Trout Origin .....Introduced
Lake Trout Potential Annual Yield
.....82 kg or 1.04 kg/ha
Lake Trout Reproduction.....Limited natural reproduction (holding basin)
Stress Factors.....Marginal summer water quality (dissolved oxygen)

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1991 (May 19-Sept. 8)	132.4	1.7	n/a	

FISHERIES SUMMARY

Natural water level regime.

Potspoon Lake should be managed as a holding basin to provide put and delayed take lake trout angling opportunities. Future management efforts should include maintaining or enhancing existing habitat, resolving access problems, minimizing illegal lake trout harvest, planting hatchery reared lake trout and establishing a baseline fisheries data series.

SHORLINE DEVELOPMENT

Residences
- permanent 3
- seasonal.....14
- total 17

Private Vacant Lots.....7

Tourist Establishments
- number .....–
- rooms/cabins.....–
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown.....15
% Shoreline Patent.....85

Rainy Lake

LOCATION

County ..... Lennox and Addington
Township ..... Effingham
Watershed ..... Skootamatta River
Angling Division 29

MORPHOMETRY

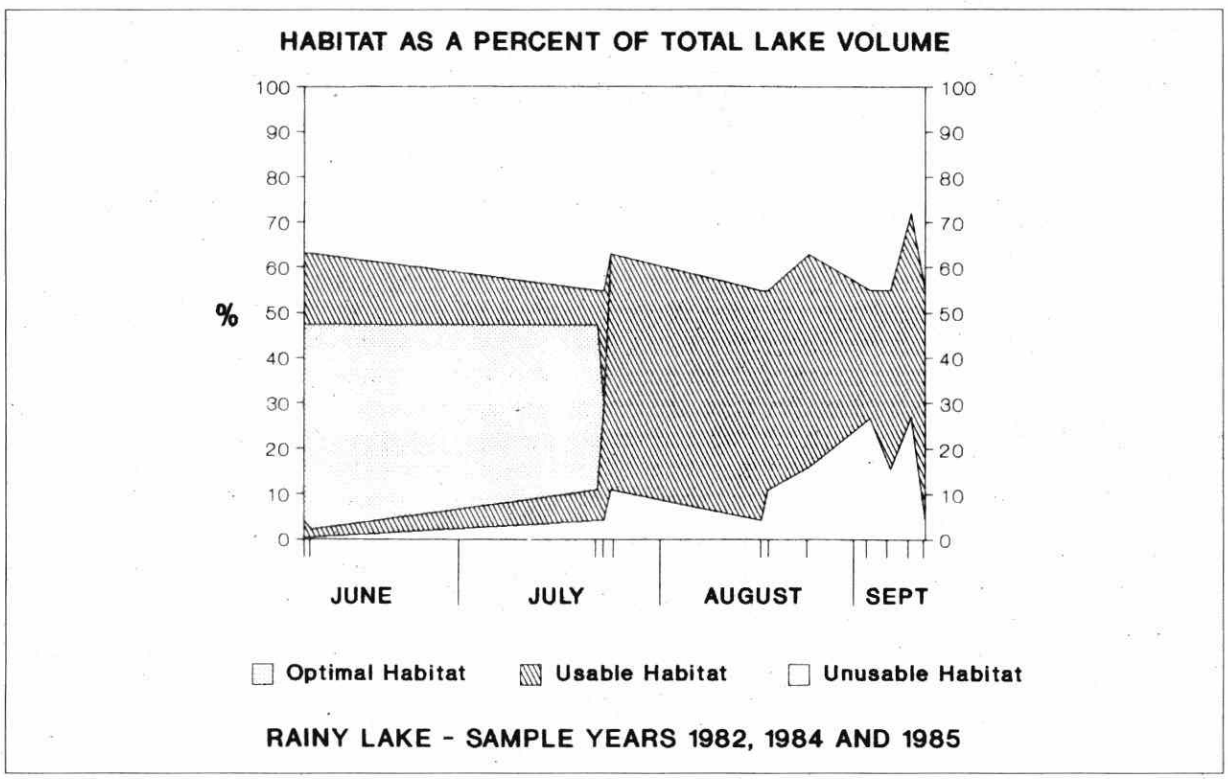
Surface Area ..... $0.450 \times 10^6 m^2$
Epilimnion Volume ..... $3.129 \times 10^6 m^3$
Hypolimnion Volume ..... $1.149 \times 10^6 m^3$
Total Volume ..... $4.278 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 2.723
Maximum Depth ..... 17.0 m
Mean Depth ..... 9.5 m

HYDROLOGY

Watershed Area ..... $10.99 \times 10^6 m^2$
Flushing Rate ..... 0.89 times/year
Outflow Volume ..... $3.805 \times 10^6 m^3$
Areal Water Load ..... 8.42 m
Retention Coefficient 0.60

WATER QUALITY

Mean Summer Secchi Disc ..... 2.32 m
Chlorophyll a ..... 2.2 µg/L
Total Phosphorus ..... 13 µg/L
Total Nitrogen ..... 452 µg/L
TDS ..... 33.5 mg/L
Depth of Water Column — Optimal ..... 0 m
— Usable ..... 4 m
Optimal Habitat as a Percentage of Total Lake Volume 0
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume 28
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1982, 1984 and 1985 surveys of Rainy Lake reveal poor water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is depleted early in the stratified season. The lake trout habitat model predicts that Rainy Lake is highly sensitive to loss of the remaining lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sports Species .....Lake trout
Lake Trout Origin .....Introduced
Lake Trout Potential Annual Yield
.....28 kg or 0.63 kg/ha
Lake Trout Reproduction.....Limited natural reproduction
Stress Factors.....Marginal water quality (dissolved oxygen) in summer

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	0.0	0.0	n/a	
1990 (March 10-31)	0.0	0.0	n/a	
1991 (March 9-30)	35.7	0.8	n/a	
(May 19-Sept. 8)	480.5	10.7	n/a	
1992 (March 14-31)	16.0	0.4	n/a	

FISHERIES SUMMARY

Rainy Lake presently supports a remnant lake trout population which should be managed to maintain or enhance its status.

Future management efforts should include phasing out hatchery reared plantings of lake trout, preventing illegal lake trout harvest, maintaining or enhancing existing habitat and establishing a baseline fisheries data series. Assessment programs should be initiated to evaluate natural reproduction and determine the status of the resident lake trout population.

SHORELINE DEVELOPMENT

The lake is surrounded by Crown land; there is one hunt camp.

Red Horse Lake

LOCATION

County.....Leeds
Township.....Rear of Leeds and Lansdowne
Watershed.....Gananoque River
Angling Division.....10

MORPHOMETRY

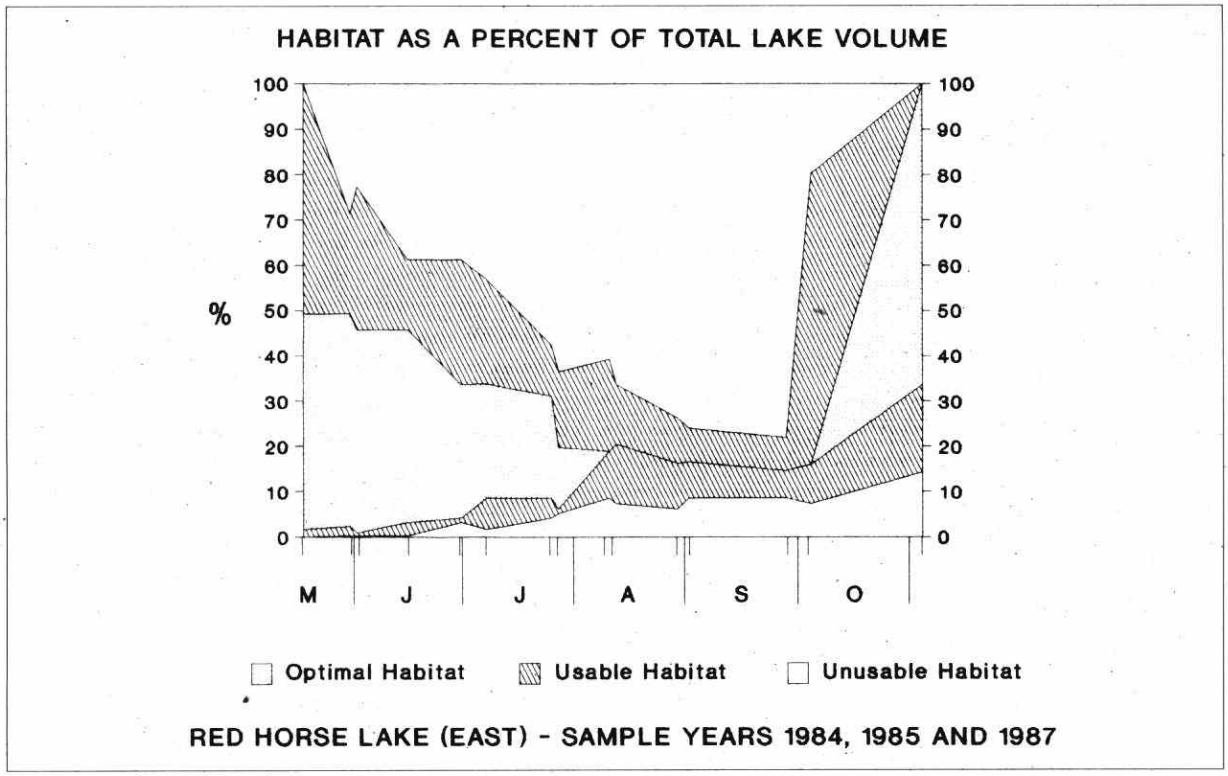
Surface Area.....3.020 x $10^6 m^2$
Epilimnion Volume.....18.720 x $10^6 m^3$
Hypolimnion Volume.....11.900 x $10^6 m^3$
Total Volume.....30.620 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion.....1.573
Maximum Depth.....36.9 m
Mean Depth.....10.1 m

HYDROLOGY

Watershed Area.....335.00 x $10^6 m^2$
Flushing Rate.....3.82 times/year
Outflow Volume.....117.02 x $10^6 m^3$
Areal Water Load.....38.74 m
Retention Coefficient.....0.24

WATER QUALITY

Mean Summer Secchi Disc.....3.4 m
Chlorophyll a.....5.2 µg/L
Total Phosphorus.....25 µg/L
Total Nitrogen.....486 µg/L
TDS.....99.45 mg/L
Depth of Water Column — Optimal.....0 m
— Usable.....21 m
Optimal Habitat as a Percentage of Total Lake Volume.....0
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of Total Lake Volume.....48
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index.....100+
Classification.....Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Red Horse Lake reveal only marginal water quality conditions for lake trout. Average chlorophyll levels are very high when compared with the other lake trout lakes. The temperature and oxygen profiles show optimal habitat is depleted late in the stratified season.

The lake trout habitat model predicts that Red Horse Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass, northern pike
Lake Trout Origin .....Native (supplemented by regular plantings)
Lake Trout Potential Annual Yield .....296 kg or 0.98 kg/ha
Lake Trout Reproduction.....Limited natural reproduction (holding basin)
Stress Factors.....Excessive angler harvest (historical) and degradation of spawning beds

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1977 (June 6-Sept 9)	10,004.4	33.1	38	n/a
1991 (June 1-Sept. 8)	1,742.6	5.8	n/a	

FISHERIES SUMMARY

Water levels controlled by Gananoque Light and Power Company.

Annual lake trout fishing pressure prior to 1987 was approximately 3,700 angler hours (12 hrs/ha) with an estimated harvest of 225 trout (164 kg).

Red Horse Lake presently supports a poor lake trout population and should be managed as a holding basin to provide put and delayed take angling opportunities. Future management efforts should include protecting and enhancing existing habitat, preventing illegal lake trout harvest, planting hatchery reared lake trout and establishing a baseline fisheries data series.

Negotiations should continue with Gananoque Light and Power Company to implement appropriate water level regimes favourable for lake trout spawning, egg incubation and rearing.

Efforts should also be directed at reducing the lake trout harvest by such means as shorter seasons, reduced daily catch and possession limits and/or bait restrictions.

SHORELINE DEVELOPMENT

Residences
- permanent 1
- seasonal.....29
- total 30

Private Vacant Lots 26

Tourist Establishments
- number 1
- rooms/cabins 14
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown.....0
% Shoreline Patent.....100

Reid Lake

LOCATION

County ..... Frontenac
Township ..... Miller, South Canonto
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

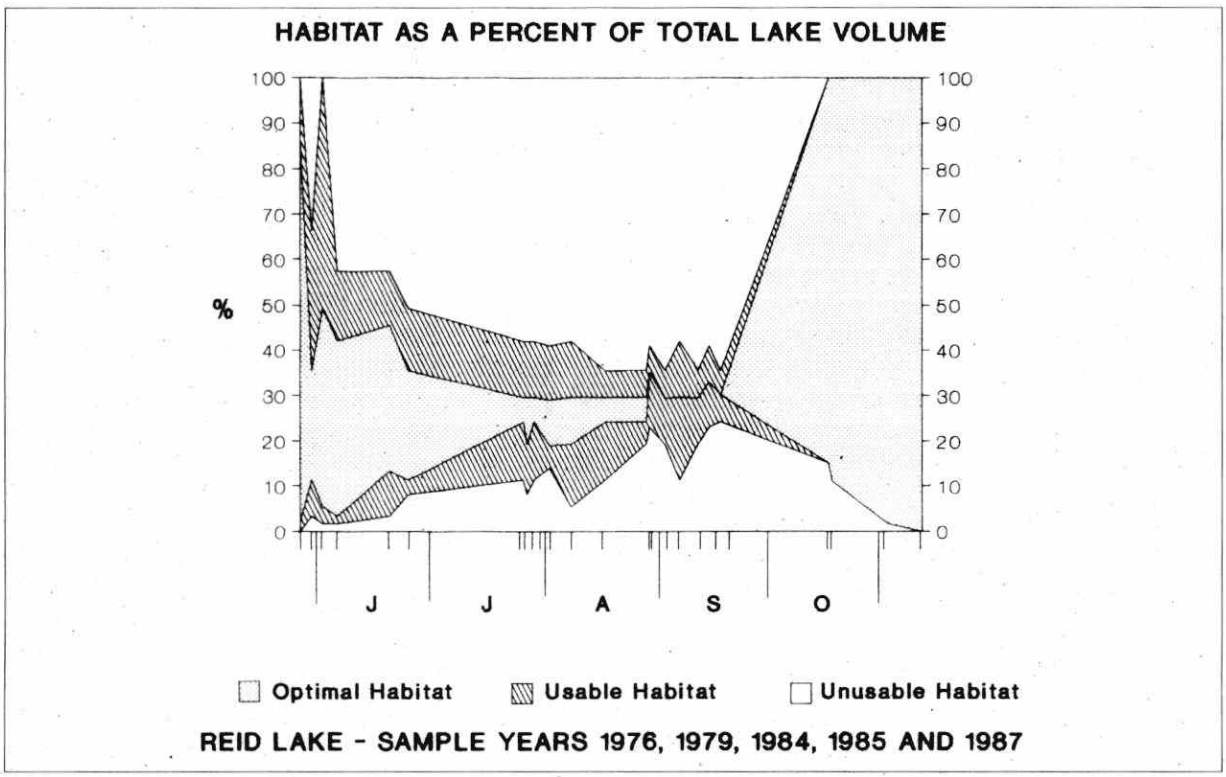
Surface Area ..... 1.050 x $10^6 m^2$
Epilimnion Volume ..... 6.600 x $10^6 m^3$
Hypolimnion Volume ..... 1.490 x $10^6 m^3$
Total Volume ..... 8.090 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 4.415
Maximum Depth ..... 19.8 m
Mean Depth ..... 7.7 m

HYDROLOGY

Watershed Area ..... 6.83 x $10^6 m^2$
Flushing Rate ..... 0.27 times/year
Outflow Volume ..... 2.17 x $10^6 m^3$
Areal Water Load ..... 2.06 m
Retention Coefficient 0.86

WATER QUALITY

Mean Summer Secchi Disc ..... 5.8 m
Chlorophyll a ..... 1.6 µg/L
Total Phosphorus ..... 13.0 µg/L
Total Nitrogen ..... 380 µg/L
TDS ..... 35.10 mg/L
Depth of Water Column — Optimal ..... 0 m
— Usable ..... 3 m
Optimal Habitat as a Percentage of Total Lake Volume 0
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 18
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm O_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

Surveys of Reid Lake reveal only marginal water quality conditions for lake trout. Although average chlorophyll levels are low, temperature and oxygen profiles show optimal habitat is depleted late in the stratified season.

The lake trout habitat model predicts that Reid Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin .....Native
(supplemented by some small plantings)
Lake Trout Potential Annual Yield
.....70 kg or 0.67 kg/ha

Lake Trout Reproduction.....Limited
natural reproduction (holding basin)
Stress Factors .....Marginal summer water quality

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	438.0	4.2	0.0	n/a
1990 (March 10-31)	316.6	3.0	27	0.29
1991 (March 9-30)	852.7	8.1	n/a	
(May 19-Sept. 8)	1,543.0	14.7	n/a	
1992 (March 14-31)	942.0	9.0	n/a	

FISHERIES SUMMARY

Natural water level regime.

The present status of the lake trout population in Reid Lake may be regarded as fair. Reid Lake should be managed as a holding basin to provide put and delayed take lake trout fishery through regular plantings of hatchery reared lake trout.

Other efforts should include implementing programs to establish baseline information on fishing pressure and harvest, protecting existing lake trout habitat and preventing illegal harvest. Assessment programs should be initiated to monitor the status of the resident lake trout populations.

SHORELINE DEVELOPMENT

The lake is surrounded by Crown land.

Round Schooner Lake

LOCATION

County ..... Frontenac
Township ..... Miller
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

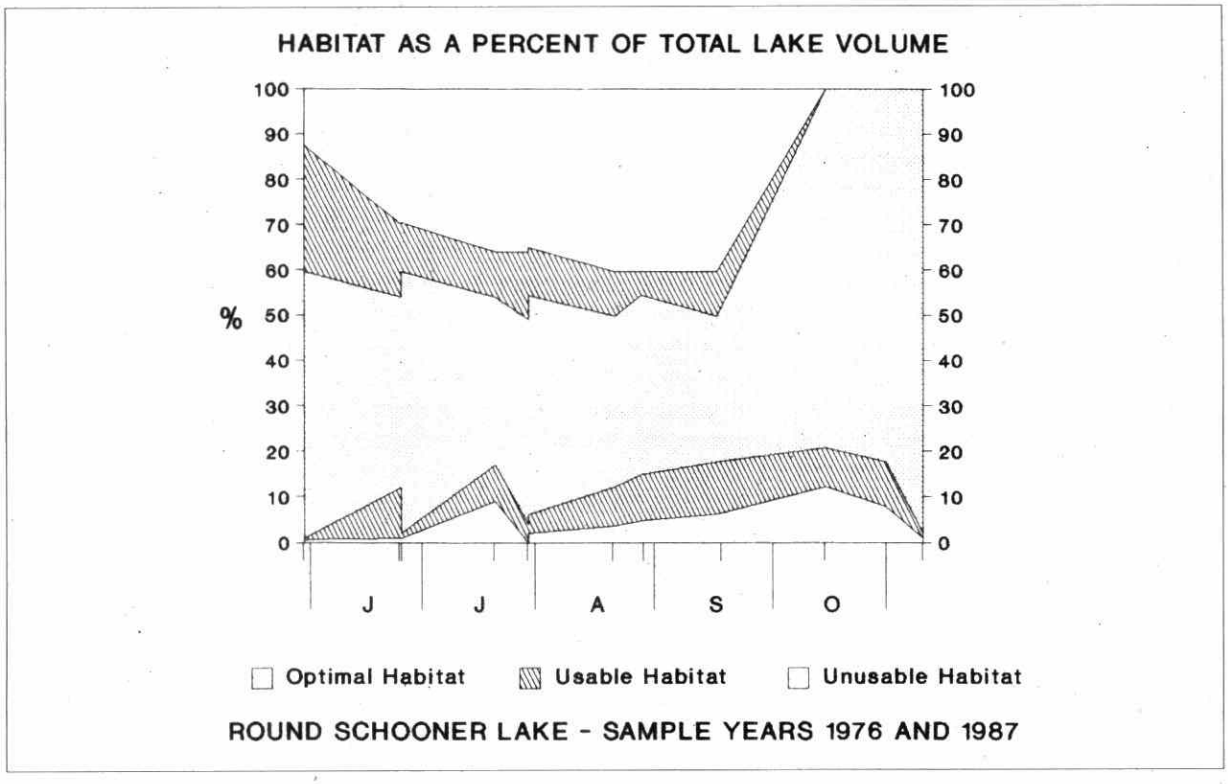
Surface Area ..... 1.920 x $10^6 m^2$
Epilimnion Volume ..... 16.120 x $10^6 m^3$
Hypolimnion Volume ..... 12.740 x $10^6 m^3$
Total Volume ..... 28.860 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.265
Maximum Depth ..... 32.0 m
Mean Depth ..... 15.0 m

HYDROLOGY

Watershed Area ..... 76.10 x $10^6 m^2$
Flushing Rate ..... 0.91 times/year
Outflow Volume ..... 26.36 x $10^6 m^3$
Areal Water Load ..... 13.73 m
Retention Coefficient 0.47

WATER QUALITY

Mean Summer Secchi Disc ..... 6.1 m
Chlorophyll a ..... 2.1 µg/L
Total Phosphorus ..... 10.0 µg/L
Total Nitrogen ..... 298 µg/L
TDS ..... 67.60 mg/L
Depth of Water Column — Optimal ..... 8 m
— Usable ..... 12 m
Optimal Habitat as a Percentage of
Total Lake Volume 32
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 45
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index 38
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

The 1976 and 1987 surveys of Round Schooner Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Round Schooner Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass, northern pike
Lake Trout Origin .....Native (supplemented by some small plantings)
Lake Trout Potential Annual Yield .....129 kg or 0.67 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors.....None identified

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1979 (Winter)	326.0	1.7	n/a	
1989 (March 11-31)	499.5	2.6	0.0	n/a
1990 (March 10-31)	431.1	2.3	n/a	
1991 (March 9-30)	1,022.5	5.3	n/a	
(May 19-Sept. 8)	283.9	1.5	n/a	
1992 (March 14-31)	836.8	4.4	n/a	

FISHERIES SUMMARY

Natural water level regime.

Round Schooner Lake should continue to be managed for its self-sustaining lake trout population. This would involve maintaining or improving existing habitat, minimizing illegal lake trout harvest, and establishing a baseline fisheries data series.

Supplemental plantings of lake trout will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from the lake trout in Round Schooner Lake, a number of other local lakes will be planted with fish species including splake, rainbow trout and brook trout.

An assessment program should be implemented to monitor the status of the resident lake trout population.

SHORELINE DEVELOPMENT

The lake is surrounded by Crown land.

Shabomeka Lake

LOCATION

County ..... Frontenac
Township ..... Barrie
Watershed ..... Mississippi River
Angling Division 29

MORPHOMETRY

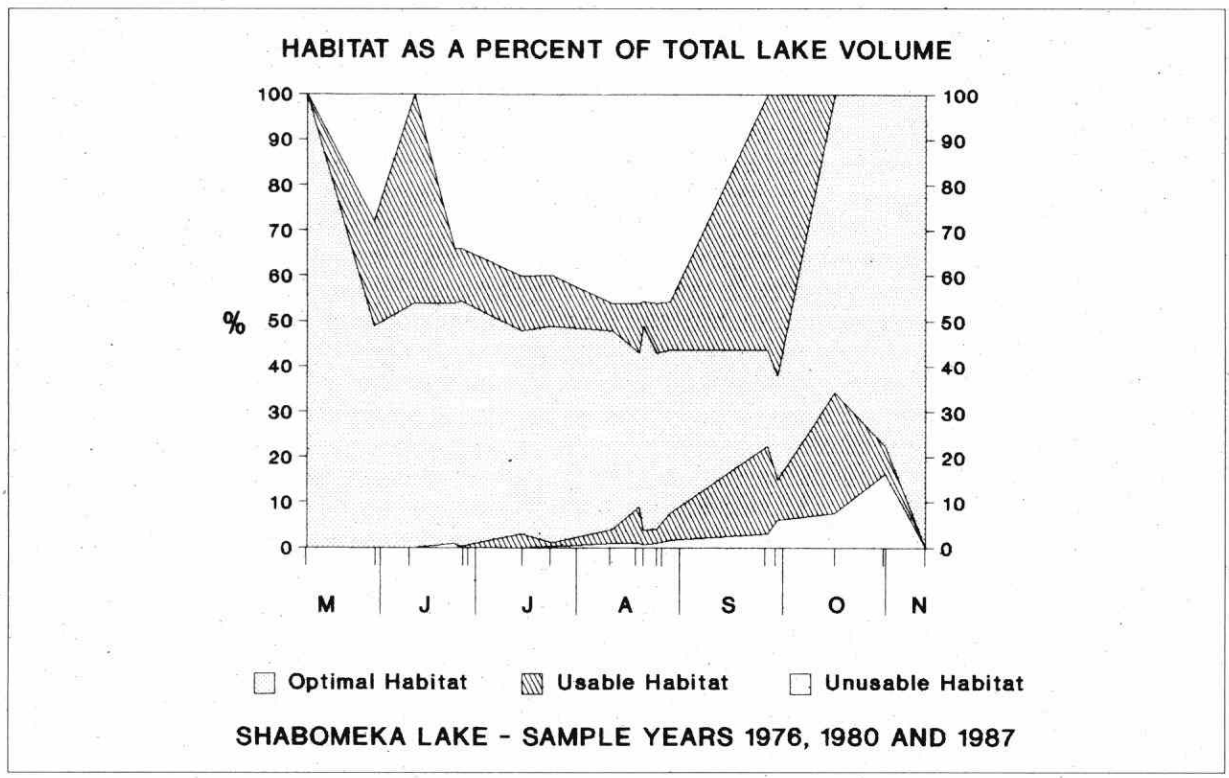
Surface Area ..... 2.680 x $10^6 m^2$
Epilimnion Volume ..... 22.610 x $10^6 m^3$
Hypolimnion Volume ..... 11.380 x $10^6 m^3$
Total Volume ..... 33.990 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.987
Maximum Depth ..... 32.0 m
Mean Depth ..... 12.7 m

HYDROLOGY

Watershed Area ..... 40.91 x $10^6 m^2$
Flushing Rate ..... 0.42 times/year
Outflow Volume ..... 14.42 x $10^6 m^3$
Areal Water Load ..... 5.38 m
Retention Coefficient 0.70

WATER QUALITY

Mean Summer Secchi Disc ..... 5.2 m
Chlorophyll a ..... 1.8 µg/L
Total Phosphorus ..... 9.0 µg/L
Total Nitrogen ..... 332 µg/L
TDS ..... 52.00 mg/L
Depth of Water Column — Optimal ..... 8 m
— Usable ..... 19 m
Optimal Habitat as a Percentage of
Total Lake Volume 27
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 52
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index 52
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1976, 1980 and 1987 surveys of Shabomeka Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Shabomeka Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass
Lake Trout Origin .....Native (supplemented by some small plantings)
Lake Trout Potential Annual Yield .....169 kg or 0.63 kg/ha
Lake Trout Reproduction .....Significant natural reproduction
Stress Factors .....Physical loss or degradation of spawning beds and adverse water level fluctuations

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1981 (March 14-29)	437.4	1.6	n/a	
1982 (Winter)	528.0	2.0	n/a	
1989 (March 11-31)	2,338.3	8.7	164	0.53
1990 (March 10-31)	1,278.5	4.8	109	0.43
1991 (March 9-30)	5,108.7	19.1	296	0.52
(May 19-Sept. 8)	3,967.0	14.8	n/a	
1992 (March 14-31)	2,089.3	7.8	n/a	

FISHERIES SUMMARY

Water levels controlled by Mississippi Valley Conservation Authority for power generation by Ontario Hydro.

The status of the lake trout population in Shabomeka Lake is believed to be reasonably good and the lake should be managed to retain this self sustaining population. Future management efforts should include maintaining or enhancing existing habitat and establishing a baseline fisheries data series.

Negotiations should continue with Ontario Hydro to implement water level regimes which are favourable for lake trout spawning, egg incubation and early rearing.

Supplemental lake trout stocking will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from lake trout in Shabomeka Lake, a number of other local lakes will be planted with fish species including splake, rainbow trout and brook trout. An assessment program should be initiated to monitor the status of resident lake trout stocks.

SHORELINE DEVELOPMENT

Residences
- permanent 1
- seasonal 102
- total 103

Private Vacant Lots 11
Tourist Establishments
- number .....–
- rooms/cabins .....–
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown 60
% Shoreline Patent 40

Most of the cottage development is situated on the west and south shores of the lake.

Sharbot Lake (West Basin)

LOCATION

County ..... Frontenac
Township ..... Olden, Oso
Watershed ..... Rideau River
Angling Division 9

MORPHOMETRY

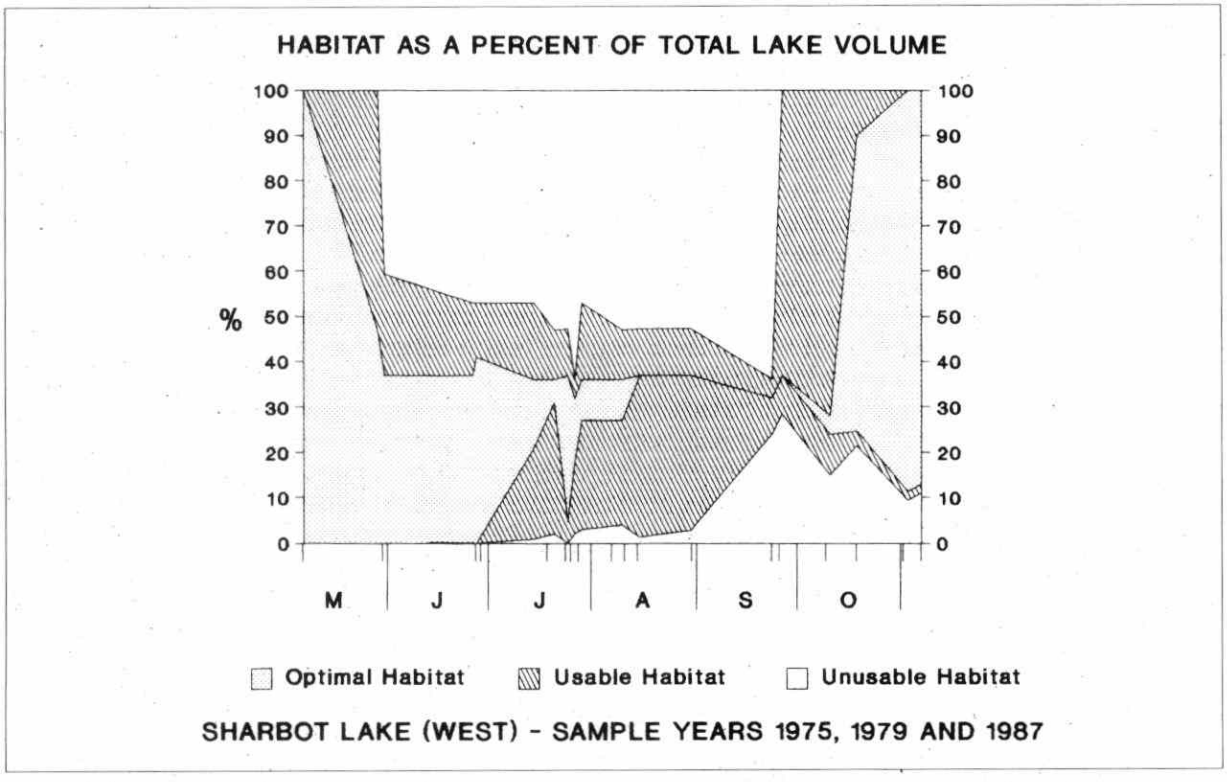
Surface Area ..... 6.840 x $10^6 m^2$
Epilimnion Volume ..... 48.452 x $10^6 m^3$
Hypolimnion Volume ..... 15.377 x $10^6 m^3$
Total Volume ..... 63.829 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 3.151
Maximum Depth ..... 31.1 m
Mean Depth ..... 9.3 m

HYDROLOGY

Watershed Area ..... 88.30 x $10^6 m^2$
Flushing Rate ..... 0.46 times/year
Outflow Volume ..... 29.57 x $10^6 m^3$
Areal Water Load ..... 4.32 m
Retention Coefficient 0.74

WATER QUALITY

Mean Summer Secchi Disc ..... 4.1 m
Chlorophyll a ..... 2.2 µg/L
Total Phosphorus ..... 12 µg/L
Total Nitrogen ..... 425 µg/L
TDS ..... 134.55 mg/L
Depth of Water Column — Optimal ..... 1 m
— Usable ..... 9 m
Optimal Habitat as a Percentage of Total Lake Volume 8
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 26
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm O_2)
Sensitivity Index 75
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1975, 1979 and 1987 surveys of Sharbot Lake reveal only marginal water quality conditions for lake trout. Although average chlorophyll levels are low, temperature and oxygen profiles show limited optimal habitat exists late in the stratified season.

The lake trout habitat model predicts that Sharbot Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, walleye, smallmouth bass, northern pike
Lake Trout Origin.....Native (supplemented by regular plantings)
Lake Trout Potential Annual Yield
.....814 kg or 1.19 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Excessive angler harvest, degradation of spawning beds and marginal summer water quality

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1991 (June 1-Sept. 8)	10,075.0	14.7	n/a	

FISHERIES SUMMARY

Natural water level regime.

Estimated winter fishing pressure is 6,173 angler hours (9 hrs/ha) with an associated harvest of 386 lake trout (304 kg).

Sharbot Lake's resident lake trout population is believed to be in good, but depressed, condition. The lake should be managed to protect the resident lake trout population from overharvest by such means as shorter open seasons, reduced daily catch and possession limits and/or bait restrictions. Efforts should also be made to protect and enhance existing fisheries habitat, prevent illegal harvest and implement programs to establish baseline information on fishing pressure and harvest.

Supplemental lake trout plantings will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from lake trout in Sharbot Lake, a number of other local lakes will be planted with fish species including splake, rainbow trout and brook trout.

SHORELINE DEVELOPMENT

Residences
- permanent.....34
- seasonal.....128
- total.....162

Private Vacant Lots.....39
Tourist Establishments
- number.....3
- rooms/cabins.....31
- campsites.....–

Provincial Park Campsites.....185
% Shoreline Crown.....5
% Shoreline Patent.....95

The heavily developed hamlet of Sharbot Lake is located on the peninsula separating the two basins of the lake. Sharbot Lake Provincial Park is on the West Basin.

Silver Lake

LOCATION

County .....Frontenac, Lanark
Township .....Oso, South Sherbrooke
Watershed.....Fall River (Mississippi River System)
Angling Division 10

MORPHOMETRY

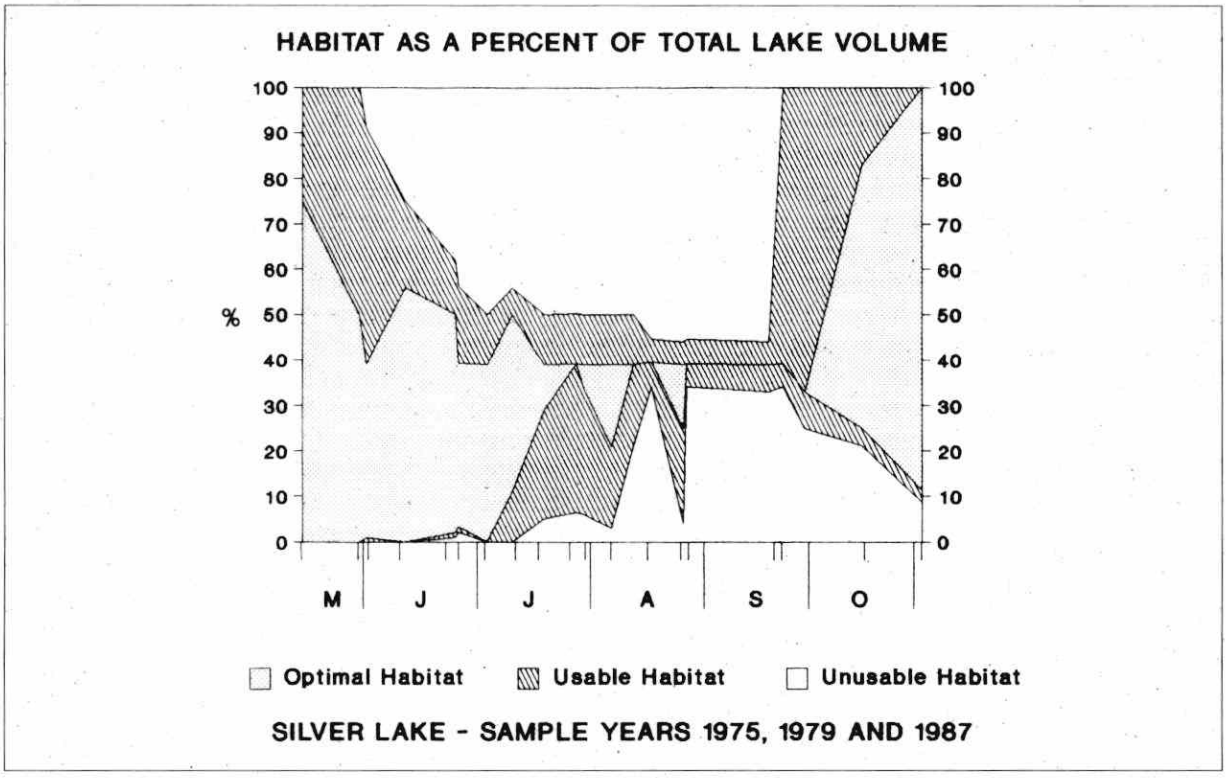
Surface Area .....2.460 x $10^6 m^2$
Epilimnion Volume.....17.880 x $10^6 m^3$
Hypolimnion Volume .....7.462 x $10^6 m^3$
Total Volume .....25.342 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 2.396
Maximum Depth .....24.4 m
Mean Depth .....10.2 m

HYDROLOGY

Watershed Area .....29.69 x $10^6 m^2$
Flushing Rate .....0.42 times/year
Outflow Volume.....10.47 x $10^6 m^3$
Areal Water Load.....4.26 m
Retention Coefficient.....0.74

WATER QUALITY

Mean Summer Secchi Disc .....3.9 m
Chlorophyll a.....2.6 µg/L
Total Phosphorus .....11.0 µg/L
Total Nitrogen .....372 µg/L
TDS .....172.90 mg/L
Depth of Water Column — Optimal .....3 m
— Usable .....6 m
Optimal Habitat as a Percentage of
Total Lake Volume 0
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 11
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index .....100+
Classification .....Highly Sensitive



WATER QUALITY SUMMARY

The 1975, 1979 and 1987 surveys of Silver Lake reveal poor water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate optimal habitat is depleted early in the stratified season.

According to the lake trout habitat model predictions, Silver Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species ....Lake trout, splake, smallmouth bass, northern pike
Lake Trout Origin .....Introduced (supplemented by some small plantings)
Lake Trout Potential Annual Yield .....317 kg or 1.29 kg/ha
Lake Trout Reproduction.....Limited natural reproduction (holding basin)
Stress Factors.....Excessive angler harvest (historical), marginal summer water quality, degradation of spawning beds and introduction of undesirable fish species

FISHERIES SUMMARY

Natural water level regime.

Annual lake trout fishing pressure is estimated at 3,200 angler hours (13 hrs/ha) with an associated harvest of 120 trout (81.8 kg).

Silver Lake should continue to be managed as a holding basin to provide put and delayed take lake trout angling opportunities. This would involve planting hatchery reared lake trout on a regular basis.

Efforts should be made to protect the resident population from overharvest by such means as shorter open seasons, reduced daily catch and possession limits and/or bait restrictions.

Existing fisheries habitat must be protected and efforts should be directed to enhancing spawning shoals. Enforcement activities should be directed toward preventing illegal harvest.

Programs should also be implemented to establish baseline information on fishing pressure and harvest. An assessment program should be initiated to monitor the success of lake trout stocking and further evaluate the lake's designation for lake trout management.

SHORELINE DEVELOPMENT

Residences
- permanent 5
- seasonal.....51
- total 56

Private Vacant Lots.....12
Tourist Establishments
- number 1
- rooms/cabins 18
- campsites .....–

Provincial Park Campsites.....148

% Shoreline Crown.....10
% Shoreline Patent.....90

Silver Lake Provincial Park is located at the east end of the lake. Highway 7 runs close to the south side. Development is moderate and mostly located along the north and east shores.

Simpson Lake

LOCATION

County ..... Lennox and Addington
Township ..... Ashby
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

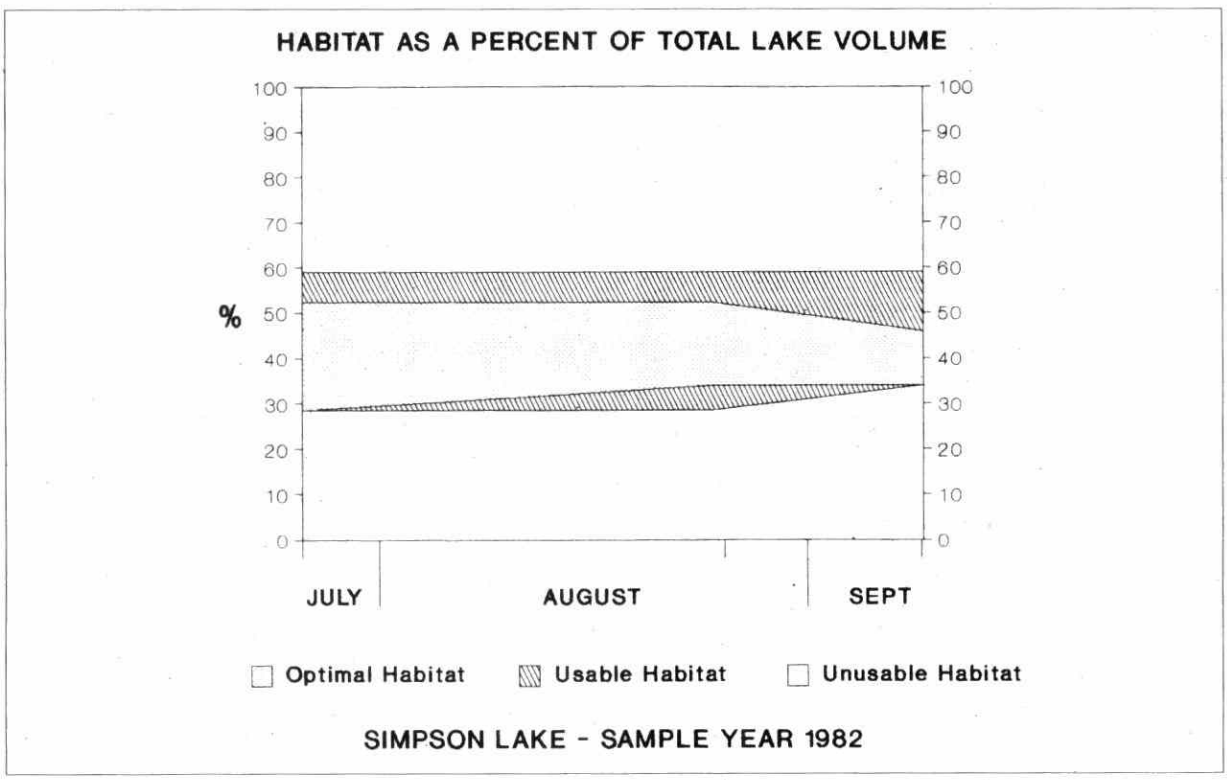
Surface Area ..... 0.250 x $10^6 m^2$
Epilimnion Volume ..... 1.751 x $10^6 m^3$
Hypolimnion Volume ..... 0.901 x $10^6 m^3$
Total Volume ..... 2.652 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.943
Maximum Depth ..... 18.6 m
Mean Depth ..... 10.6 m

HYDROLOGY

Watershed Area ..... 19.460 x $10^6 m^2$
Flushing Rate ..... 2.57 times/year
Outflow Volume ..... 6.819 x $10^6 m^3$
Areal Water Load ..... 27.2 m
Retention Coefficient 0.31

WATER QUALITY

Mean Summer Secchi Disc ..... 4.6 m
Chlorophyll a ..... 1.8 µg/L
Total Phosphorus ..... 10 µg/L
Total Nitrogen ..... n/a
TDS ..... n/a
Depth of Water Column — Optimal ..... 2 m
— Usable ..... 4 m
Optimal Habitat as a Percentage of Total Lake Volume 12
Aug. 31 (≤ 10°C & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 25
Aug. 31 (≤ 15.5°C & ≥ 4 ppm O_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1982 survey of Simpson Lake reveals good water quality conditions for lake trout. Average chlorophyll levels are consistently low. Temperature and oxygen profiles indicate optimal lake trout habitat is present throughout the stratified season. The lake trout habitat model predicts that Simpson Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sports Species.....Lake trout, lake whitefish
Lake Trout Origin.....Native (supplemented by plantings)
Lake Trout Potential Annual Yield .....25 kg or 0.98 kg/ha
Lake Trout Reproduction.....Limited natural reproduction (holding basin)
Stress Factors.....None identified

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	0.0	0.0	n/a	
1990 (March 10-31))	0.0	0.0	n/a	
1991 (March 9-30)	13.7	0.6	n/a	
(May 19-Sept. 8)	1,022.3	40.9	n/a	
1992 (March 14-31)	0.0	0.0	n/a	

FISHERIES SUMMARY

Simpson Lake presently supports a remnant lake trout population and should be managed as a holding basin to provide a put and delayed take lake trout fishery. Future management activities should include planting hatchery reared lake trout, maintaining or enhancing existing habitat, preventing illegal lake trout harvest and establishing a baseline fisheries data series.

SHORELINE DEVELOPMENT

The lake is surrounded by Crown land.

Thanet Lake

LOCATION

County ..... Hastings
Township ..... Lake
Watershed ..... Deer River (Trent River System)
Angling Division 7

MORPHOMETRY

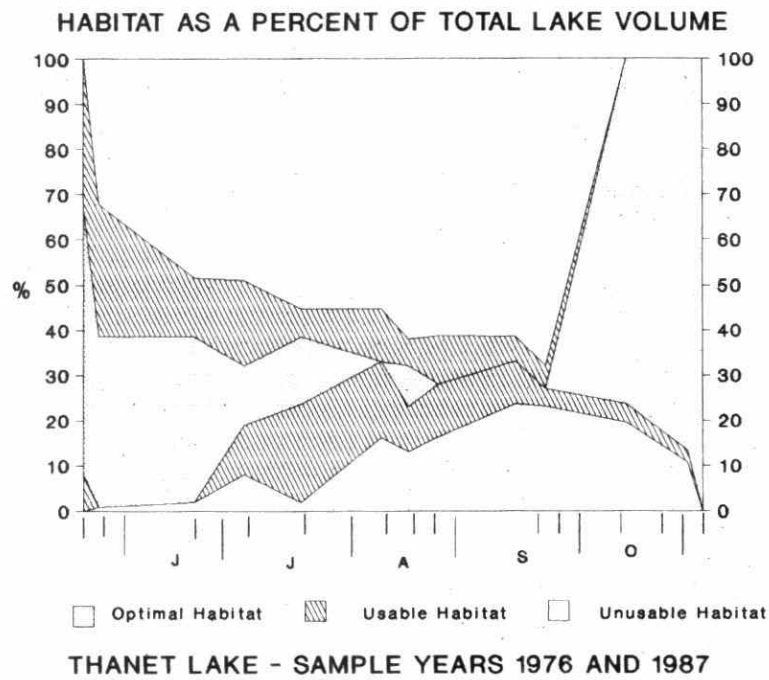
Surface Area ..... 1.120 x $10^6 m^2$
Epilimnion Volume ..... 7.090 x $10^6 m^3$
Hypolimnion Volume ..... 1.670 x $10^6 m^3$
Total Volume ..... 8.760 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 4.246
Maximum Depth ..... 24.4 m
Mean Depth ..... 7.8 m

HYDROLOGY

Watershed Area ..... 6.49 x $10^6 m^2$
Flushing Rate ..... 0.24 times/year
Outflow Volume ..... 2.12 x $10^6 m^3$
Areal Water Load ..... 1.88 m
Retention Coefficient 0.87

WATER QUALITY

Mean Summer Secchi Disc ..... 6.4 m
Chlorophyll a ..... 1.6 µg/L
Total Phosphorus ..... 13.0 µg/L
Total Nitrogen ..... 398 µg/L
TDS ..... 76.70 mg/L
Depth of Water Column — Optimal ..... 1 m
— Usable ..... 3 m
Optimal Habitat as a Percentage of
Total Lake Volume 4
Aug. 31 (≤ 10°C & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of
Total Lake Volume 18
Aug. 31 (≤ 15.5°C & ≥ 4 ppm O_2)
Sensitivity Index ..... 100+
Classification ..... Highly Sensitive



WATER QUALITY SUMMARY

The 1976 and 1987 surveys of Thanet Lake reveal only marginal water quality conditions for lake trout. Although average chlorophyll levels are low, temperature and oxygen profiles show limited optimal habitat exists late in the stratified season.

The lake trout habitat model predicts that Thanet Lake is highly sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass
Lake Trout Origin .....Native (supplemented by some small plantings)
Lake Trout Potential Annual Yield .....110 kg or 0.98 kg/ha
Lake Trout Reproduction.....Limited natural reproduction
Stress Factors .....Marginal summer water quality

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1983 (January 17-March 26)	841.6	7.7	17	0.14

FISHERIES SUMMARY

Natural water level regime.

Thanet Lake presently supports a small lake trout population having limited natural reproduction. Future management efforts should be directed at maintaining or enhancing this population by phasing out plantings of hatchery reared fish, reducing illegal harvest and preventing the harmful alteration and/or destruction of fish habitat.

SHORELINE DEVELOPMENT

Residences
- permanent .....–
- seasonal.....4
- total 4

Private Vacant Lots.....1

Tourist Establishments
- number .....–
- rooms/cabins .....–
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown.....60
% Shoreline Patent.....40

Trout (Len) Lake

LOCATION

County ..... Lennox and Addington
Township ..... Ashby
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

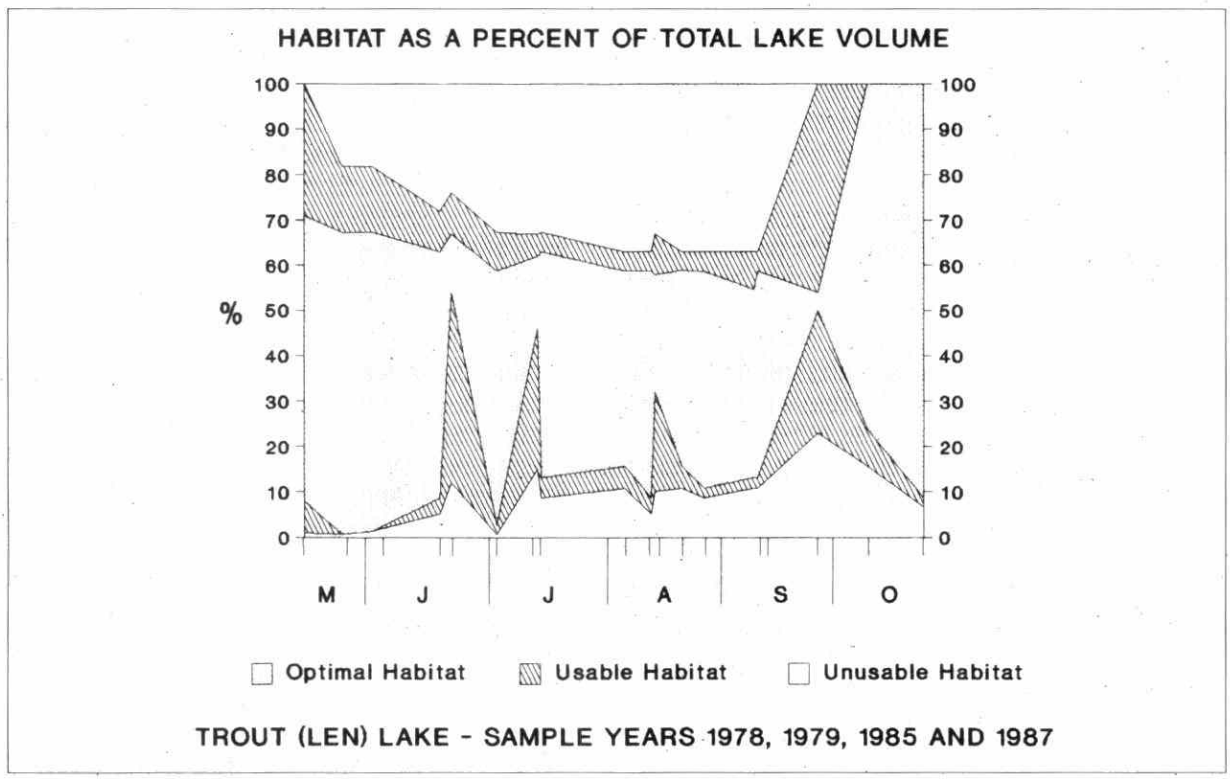
Surface Area ..... $1.580 \times 10^6 m^2$
Epilimnion Volume ..... $12.280 \times 10^6 m^3$
Hypolimnion Volume ..... $10.630 \times 10^6 m^3$
Total Volume ..... $22.910 \times 10^6 m^3$
Ratio of Epilimnion to Hypolimnion 1.156
Maximum Depth ..... 33.5 m
Mean Depth ..... 14.5 m

HYDROLOGY

Watershed Area ..... $22.3 \times 10^6 m^2$
Flushing Rate ..... 0.32 times/year
Outflow Volume ..... $7.50 \times 10^6 m^3$
Areal Water Load ..... 4.75 m
Retention Coefficient 0.72

WATER QUALITY

Mean Summer Secchi Disc ..... 5.4 m
Chlorophyll a ..... 1.5 µg/L
Total Phosphorus ..... 11.4 µg/L
Total Nitrogen ..... 299 µg/L
TDS ..... 85.80 mg/L
Depth of Water Column — Optimal ..... 6 m
— Usable ..... 16 m
Optimal Habitat as a Percentage of Total Lake Volume 20
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm O_2)
Usable Habitat as a Percentage of Total Lake Volume 57
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm O_2)
Sensitivity Index 40
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

Surveys of Trout Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Trout Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout
Lake Trout Origin.....Native
(supplemented by some small plantings)
Lake Trout Potential Annual Yield
.....120 kg or 0.76 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Angling pressure

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1989 (March 11-31)	631.7	4.0	95	0.31
1990 (March 10-31)	795.0	5.0	72	0.19
1991 (March 9-30)	2,781.8	17.6	n/a	
(May 19-Sept. 8)	2,259.0	14.3	n/a	
1992 (March 14-31)	3,397.2	21.5	n/a	

FISHERIES SUMMARY

Natural water level regime.

Trout Lake should be managed to maintain the resident self-sustaining lake trout population. Future management activities should include minimizing illegal harvest, maintaining or enhancing existing habitat and establishing a baseline fisheries series.

Supplemental lake trout plantings will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from the lake trout fishery in Trout Lake, a number of other local lakes will be planted with fish species including splake, rainbow trout and brook trout.

SHORELINE DEVELOPMENT

Residences
- permanent.....–
- seasonal.....7
- total.....7

Private Vacant Lots.....1
Tourist Establishments
- number.....–
- rooms/cabins.....–
- campsites.....–

Provincial Park Campsites.....–
% Shoreline Crown.....95
% Shoreline Patent.....5

There is a Ministry of Natural Resources access point with a sand beach and boat launch at the east end of the lake that is well used by campers.

Wensley (Brule) Lake

LOCATION

County ..... Frontenac
Township ..... Miller
Watershed ..... Madawaska River
Angling Division 29

MORPHOMETRY

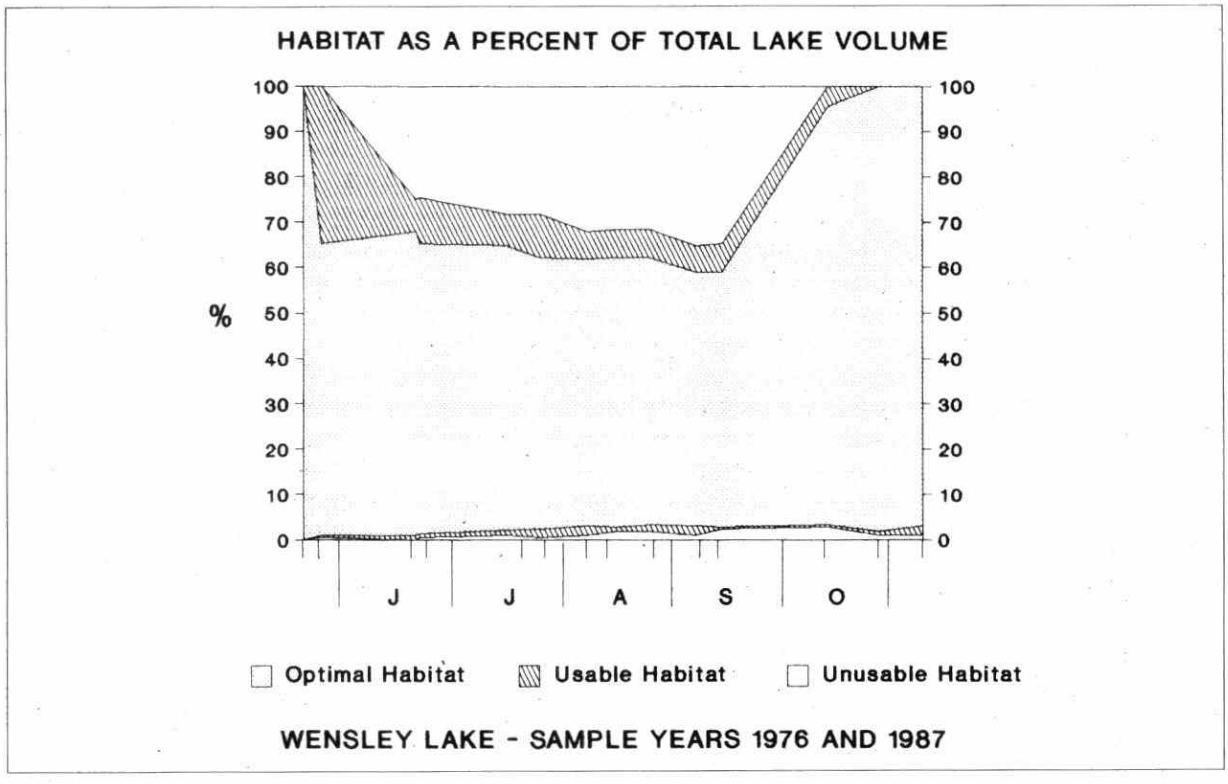
Surface Area ..... 5.710 x $10^6 m^2$
Epilimnion Volume ..... 55.730 x $10^6 m^3$
Hypolimnion Volume ..... 70.570 x $10^6 m^3$
Total Volume ..... 126.300 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion 0.697
Maximum Depth ..... 56.4 m
Mean Depth ..... 22.1 m

HYDROLOGY

Watershed Area ..... 52.8 x $10^6 m^2$
Flushing Rate ..... 0.14 times/year
Outflow Volume ..... 17.32 x $10^6 m^3$
Areal Water Load ..... 3.0 m
Retention Coefficient 0.80

WATER QUALITY

Mean Summer Secchi Disc ..... 7.9 m
Chlorophyll a ..... 1.6 µg/L
Total Phosphorus ..... 11.0 µg/L
Total Nitrogen ..... 372 µg/L
TDS ..... 78.00 mg/L
Depth of Water Column — Optimal ..... 15 m
— Usable ..... 20 m
Optimal Habitat as a Percentage of
Total Lake Volume 56
Aug. 31 ($\leq 10°C$ & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume 65
Aug. 31 ($\leq 15.5°C$ & ≥ 4 ppm 0_2)
Sensitivity Index 10
Classification ..... Moderately Sensitive



WATER QUALITY SUMMARY

The 1976 and 1987 surveys of Wensley Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Wensley Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, smallmouth bass
Lake Trout Origin.....Native (supplemented by regular plantings)
Lake Trout Potential Annual Yield .....331 kg or 0.58 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Excessive angler harvest, degradation and loss of spawning beds

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1976	2,341.1	4.1	n/a	
1979	11,409.0	20.0	n/a	
1981	1,541.7	2.7	n/a	
1982	3,121.0	5.5	n/a	
1983 (March 12-31)	1,887.8	3.3	50	0.07
1984 (March 10-31)	2,299.7	4.0	166	n/a
1987 (March 14-31)	3,994.0	7.0	349	n/a
1989 (March 11-31)	2,916.5	5.1	318	0.44
1990 (March 10-31)	1,809.5	3.2	309	0.60
1991 (March 9-31)	4,456.1	7.8	281	0.23
(May 19-Sept. 8)	5,367.1	9.4	n/a	
1992 (March 14-31)	5,012.0	8.8	n/a	

FISHERIES SUMMARY

Natural water level regime. Annual lake trout fishing pressure exceeds 10,000 angler hours (>18 hrs/ha).

Wensley (Brule) Lake should be managed to maintain the resident, self-sustaining lake trout population. Future management efforts should include minimizing illegal harvest, maintaining or enhancing existing habitat and reducing angler harvest as required.

Supplemental lake trout plantings will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries pressure away from the lake trout population in Wensley Lake, a number of other local lakes will be planted with fish species including splake, rainbow trout and brook trout. An ongoing assessment program should be maintained in order to monitor the resident lake trout population and fishery in this heavily utilized lake.

SHORELINE DEVELOPMENT

Residences
- permanent 2
- seasonal 74
- total 76

Private Vacant Lots 7
Tourist Establishments
- number 2
- rooms/cabins 8
- campsites .....–

Provincial Park Campsites .....–
% Shoreline Crown.....35
% Shoreline Patent.....65

Most development has substantial improvements such as hydro, plumbing, gardens, lawns and boathouses.

Weslemkoon Lake

LOCATION

County.....Lennox and Addington, Hastings
Township.....Ashby, Effingham, Cashel
Watershed.....Madawaska River
Angling Division.....29

MORPHOMETRY

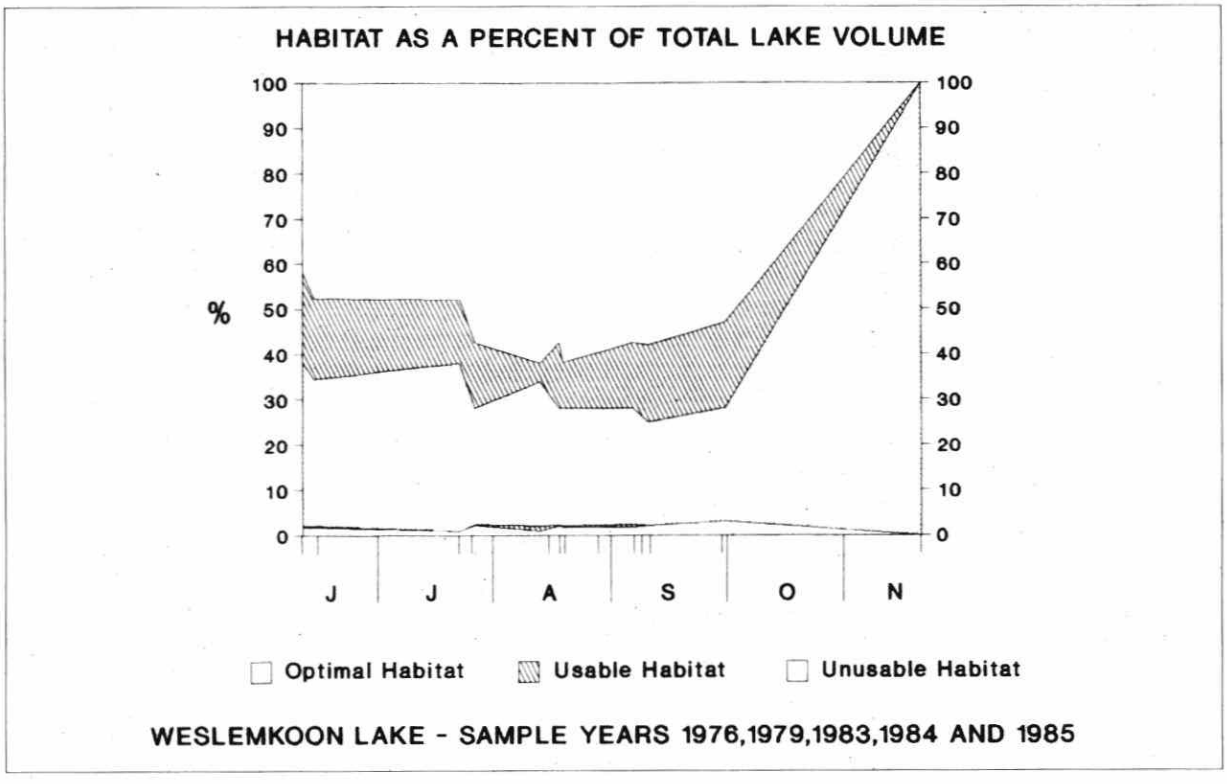
Surface Area.....19.550 x $10^6 m^2$
Epilimnion Volume.....121.700 x $10^6 m^3$
Hypolimnion Volume.....47.000 x $10^6 m^3$
Total Volume.....168.700 x $10^6 m^3$
Ratio of Epilimnion to Hypolimnion.....2.589
Maximum Depth.....54.9 m
Mean Depth.....8.6 m

HYDROLOGY

Watershed Area.....212.92 x $10^6 m^2$
Flushing Rate.....0.42 times/year
Outflow Volume.....70.63 x $10^6 m^3$
Areal Water Load.....3.61 m
Retention Coefficient.....0.77

WATER QUALITY

Mean Summer Secchi Disc.....5.3 m
Chlorophyll a.....1.4 µg/L
Total Phosphorus.....11.0 µg/L
Total Nitrogen.....345 µg/L
TDS.....29.90 mg/L
Depth of Water Column — Optimal.....20 m
— Usable.....25 m
Optimal Habitat as a Percentage of
Total Lake Volume.....27
Aug. 31 (≤ 10°C & ≥ 6 ppm 0_2)
Usable Habitat as a Percentage of
Total Lake Volume.....35
Aug. 31 (≤ 15.5°C & ≥ 4 ppm 0_2)
Sensitivity Index.....10
Classification.....Moderately Sensitive



WESLEMKOON LAKE - SAMPLE YEARS 1976,1979,1983,1984 AND 1985

WATER QUALITY SUMMARY

Surveys of Weslemkoon Lake reveal excellent water quality conditions for lake trout. Average chlorophyll levels are consistently low. The temperature and oxygen profiles indicate ample optimal habitat exists throughout the stratified season.

According to the lake trout habitat model predictions, Weslemkoon Lake is moderately sensitive to loss of the remaining optimal lake trout habitat as a result of additional nutrient loadings.

FISHERIES

Major Sport Species.....Lake trout, largemouth bass, smallmouth bass
Lake Trout Origin.....Native (supplemented by small regular plantings)
Lake Trout Potential Annual Yield
.....1134 kg or 0.58 kg/ha
Lake Trout Reproduction.....Significant natural reproduction
Stress Factors.....Excessive angler harvest and acidic precipitation (lake is poorly buffered)

CREEL INFORMATION

	Estimated Lake Trout Fishing Pressure		Estimated Lake Trout Harvest	
Year (Dates)	Angler Hours	Hrs/Ha	# Fish	Kg/Ha
1981 (March 14-29)	466.0	0.2	n/a	
1989 (March 11-31)	550.1	0.3	n/a	
1990 (March 10-31)	39.0	0.02	11	0.002
1991 (March 9-31)	406.7	0.2	n/a	
(May 19-Sept. 8)	10,566.9	5.4	n/a	
1992 (March 14-31)	649.8	0.3	n/a	

FISHERIES SUMMARY

Water levels regulated by Ministry of Natural Resources dam.

Weslemkoon Lake should be managed to maintain the resident, self sustaining lake trout population. This would involve reducing angler harvest, adhering to existing water rule curves, minimizing illegal harvest, examining mitigative techniques for lake acidification, maintaining or improving existing habitat and establishing a baseline fisheries data series.

Supplemental lake trout stocking will continue but may be reduced or phased out over the long term. In order to provide alternate fisheries and divert fishing pressure away from the lake trout population in Weslemkoon Lake, a number of other local lakes will be planted with fish species including splake, rainbow trout and brook trout.

An assessment program should be initiated to monitor the status of the resident lake trout population.

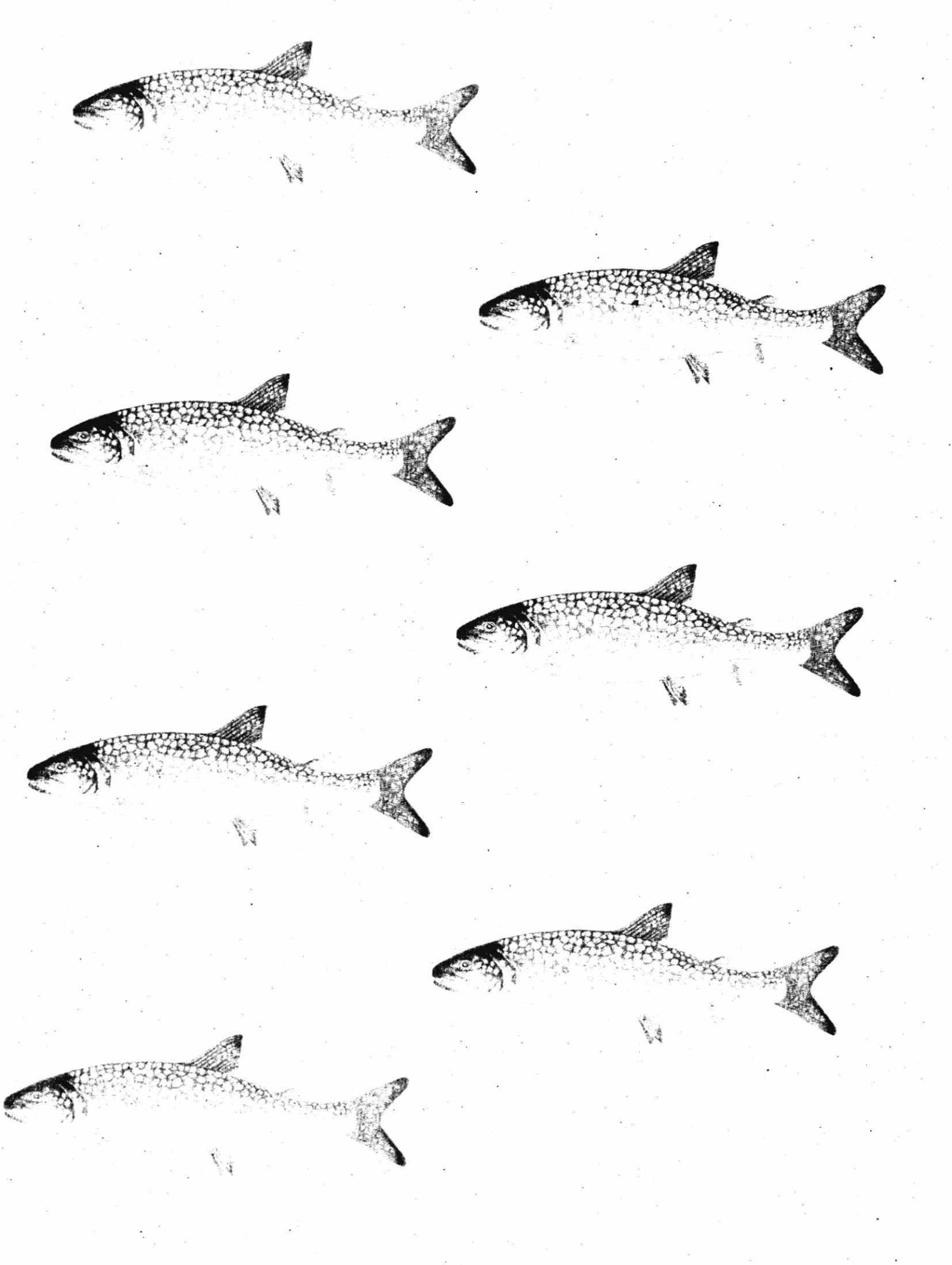
SHORELINE DEVELOPMENT

Residences
- permanent.....13
- seasonal.....285
- total.....298

Private Vacant Lots.....56
Tourist Establishments
- number.....4
- rooms/cabins.....16
- campsites.....15

Provincial Park Campsites.....–
% Shoreline Crown.....72
% Shoreline Patent.....28

Development occurs in strips distributed around the lake; most dwellings have hydro and plumbing.



Glossary of Terms

ANNUAL YIELD
the theoretical maximum of fish which can be harvested annually without exhausting the compensatory reserve of a fish community

ARTIFICIAL FISHERY
a fishery which is sustained solely or predominantly through the stocking of hatchery reared fish

BIOMASS
the total weight of organisims constituting a given trophic level or colonizing a given area or volume

CHLOROPHYLL a
green pigment found in living plants and commonly used to quantify algae levels as an indicator of lake nutrient status

CUE
acronym for catch per unit effort; this expression recognizes that catch is a function of the fishing effort expended and provides an indication of angling effort

EPILIMNION
the upper layer of water of the lake in which the water temperature remains warm in summer and rarely drops more than 2°C per two metre interval

F1 SPLAKE
first generation progeny from a cross between male brook trout and female lake trout

FISH HABITAT
spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes [s.31(5) *Fisheries Act*]

HYPOLIMNION
the lower layer of water of the lake in which the temperature remains uniformly cold from its upper limit to the bottom and rarely drops more than 2°C per two metre interval

LITTORAL ZONE
the shoreward region of a body of water generally shallow in depth having light penetration throughout the water column and inhabited by a variety of plants, animals and fish

MEROMICTIC
a condition whereby a lake cannot undergo complete mixing at the time of spring and fall overturn. Metromixis may be induced by lake morphology or lake chemical conditions or a combination of both.

METALIMNETIC MINIMA
a condition whereby oxygen is depleted to low concentrations in the metalimnion by the presence of organic oxidizable material which is prohibited from further settling into the hypolimnion due to temperature related density gradients.

METALIMNION (THERMOCLINE)
the mid layer of water of the lake separating the epilimnion and hypolimnion in which there is the most rapid decrease in summer water temperature

MIXING RATIO
the volume of water above the hypolimnion divided by the volume of the hypolimnion

MORPHOEDAPHIC INDEX
an index used to predict fish yields from a waterbody utilizing the total dissolved solids (TDS) concentration and mean depth of the lake

MORPHOMETRY
lake morphometry refers to the physical features of a lake such as shape and size

OPTIMAL LAKE TROUT HABITAT
the portion of a lake which, in midsummer, has water temperatures 10°C or cooler and dissolved oxygen concentrations of 6 µg/L or greater

SELF-SUSTAINING FISHERY
a fishery which is sustained by the natural reproduction and recruitment of a resident population of fish

STANDARDIZED LAKE TROUT HABITAT
that volume of water having temperature and oxygen conditions which meet or exceed the physiological requirements for lake trout on August 31 for any given year. The standardized habitat allows for lake to lake comparisons of volumes of water which meet the definition of optimal and usable habitat for the management of lake trout.

STRATIFICATION
thermal partitioning of the volume of water in a lake where warmer surface waters (epilimnion) are distinguished from colder deeper waters (hypolimnion) and separated by the thermocline (metalimnion)

TYPE LAKES
sets of lakes, representative of lakes and fish communities throughout the province, which are assessed through time to determine responses of fish communities to various stressors in order to then utilize this knowledge to manage other similar fisheries

USABLE LAKE TROUT HABITAT
the portion of a lake which, in midsummer, has water temperatures 15.5° C or cooler and dissolved oxygen concentrations of 4 µg/L or greater

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